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ANNALS of SURGERY

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OXYCEPHALY: REPORT OF TWO CASES *

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THE various types of cranial deformity associated with optic atrophy have been fairly familiar to the ophthalmologist for a number of years, but if I may judge from my own experience and from the comparatively meagre literature on the subject, the general physician and surgeon is poorly acquainted with this group of cases to which Bertolotti applies the term "cranio-synostose pathologique."

Of these deformities the most frequent and important is the oxycephalic type, also called by various other names, steeple or tower head, Turmschädel, Spitz-kopf, turricephaly, acrocephaly, hypsicephaly, etc. The two names which have been used most frequently and interchangeably are "turmschädel" or steeple head, and oxycephaly, and Sharpe has suggested that we consider the two names as applying to one condition which differs only in the degree of the deformity, turmschädel or steeple head for the mild form of the condition, where there is no definite prominence or protrusion at the anterior fontanelle, and oxycephaly for the more severe cases with a prominence at the anterior fontanelle.

The first case of this character was described by Von Graefe in 1866 and since that time a good many cases have been reported in the ophthalmological journals. Unfortunately, the first and most important symptom is usually the progressive loss of sight, on account of which the patient is sooner or later, usually later, taken to the oculist and generally little or no attention has been paid to the cranial deformity. Since the dimming of vision usually occurs in early childhood it is often not recognized until the optic atrophy is far advanced, therefore I think it is to be deplored that the family physician and children's doctor are not more familiar with the fact that certain types of cranial deformity are apt to be associated with optic atrophy, as I believe that if X-ray pictures were made of these pathological varieties of skull deformity in early life, a diagnosis could be made in many cases and optic atrophy prevented by an early decompression to relieve the increased intracranial pressure. The importance of oxycephaly as a cause of blindness is shown by the

* Read before the Southern Surgical Association, December 18, 1919.

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fact that Meltzer was able to report 20 cases of this character from one institution for the blind in Germany.

Etiology.—Many theories have been advanced to account for the cranial deformity and the associated disturbance of the optic nerve. As regards the cranial deformity it is now generally believed to be due to a premature synostosis of the parietal bones with the occipital and temporal bones, with a compensatory enlargement in the region of the sagittal suture and in the frontal region. The cause of this premature synostosis is not known. It has been attributed by some to rickets but most of the cases have shown no other signs of rickets, no rosary, no enlargement of the epiphyses, no curvatures of the long bones, etc.; moreover, in rickets the closure of the sutures is usually delayed and the deformity of the head is different. Of the forty cases in the collective reviews of Enslin and Patry none showed any signs of rickets. Others believe the synostosis is due to irritation of the sutures by a meningitis involving the dura, but there seems to be little to support this theory. Virchow thought that a congested condition of the skull contents without actual inflammation might cause synostosis. Schüller is of the opinion that the premature synostosis is an evidence of a developmental disturbance which shows itself in the skull and not in the rest of the skeleton, but this theory still leaves us ignorant of the primary cause. In one of my cases two years after a bilateral subtemporal decompression the X-ray shows practically complete ossification over the protruding brain, and I have wondered whether the tendency to new bone formation might be of any significance in this connection.

The optic atrophy has been ascribed to meningitis, to local changes in the optic foramina making pressure on the optic nerves, and to the increased intra-cranial pressure. Meningitis can probably be dismissed with few words since, if it were the cause, the other cranial nerves would be more frequently involved. Pressure on the nerves in the region of the optic foramina has been attributed to narrowing of the foramina by distortion or by hyperostosis, but in only one or two cases has autopsy shown any evidence of such narrowing. A few years ago von Behr claimed to have found that in many cases of oxycephaly the distortion of the skull displaces the carotid sulcus forward in such a way that the carotid artery does not lie to the outer side of the nerve but beneath it, and as the artery turns backward in its sagittal course it forms the lower wall of the optic canal, thus compressing the nerve and causing the atrophy. In 1913 Schloffer examined a number of oxycephalic skulls and in many found relations apparently confirming Behr's theory. After practicing the operation on the cadaver he removed the roof of the optic canal, by a two-stage operation, in two cases of oxycephaly with rather advanced optic atrophy, the operation being confined to one side in each case. In one case which was followed only a few weeks there was no change in the eye, but in the other case, after three weeks, light per-

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ception returned, a result which had not been accomplished by a previous decompression. He says that further experience only will show whether this operation, which he calls the "Kanal operation," is valuable, but he thinks it may at least be justifiable when a previous decompression has failed.

A number of cases have been reported in which a definite condition of choked disk has been seen preceding the optic atrophy, and most authors believe that the optic nerve changes are due to an increased intracranial pressure, just as they are in cases of cerebral tumor. There has been some difference of opinion regarding the cause of the increased pressure, most observers believing it to be due to the disproportionate growth of the brain and skull, while some, notably Meltzer, Vorschütz, and Bramann, think it is due to an internal hydrocephalus.

Those holding the former view call attention to the fact that owing to the premature synostosis the skull cannot keep pace with the expanding brain, which grows very rapidly in the early years of life, consequently the skull becomes deformed and the constant pressure of the brain causes an atrophy of the skull even to the extent of producing considerable openings in it, "spontaneous decompression."

Meltzer thinks the increased intracranial pressure is due chiefly to internal hydrocephalus, the result of a serous meningitis, but few autopsies have shown any chronic dilatation of the ventricles. Of six cases with autopsy, collected by Schumacher, hydrocephalus was found in only one. In Vorschütz's case the hydrocephalus was due to the cerebellum being jammed in the foramen magnum. Internal hydrocephalus is certainly not constant, in fact, is apparently rare with oxycephaly and, when it does occur, is probably secondary.

Oxycephaly occurs much more frequently in males than in females, the proportion being about 5 to 1; of 17 cases collected by Friedenwald, 15 were males and 2 were females; of the 8 cases of Oberwarth 6 were males. Heredity seems to have little influence, though cases have been reported in two brothers or two sisters.

The mentality is usually unimpaired, in fact, the cases seem unusually bright, considering that they are often handicapped by poor vision or blindness.

Symptoms and Signs.—In some cases there are no subjective symptoms, the skull apparently accommodating itself to the growing brain. In many cases there is headache and occasionally there is vomiting and convulsions. When these come on suddenly we might think of the possibility of an internal hydrocephalus. The cardinal signs are (1) the type of cranial deformity; (2) the exophthalmos with strabismus; (3) the impairment of vision.

The cranial deformity is generally very characteristic (Figs. 1 and 2). The skull is of unusual height and its apex, just behind the region of the anterior fontanelle, is usually formed by a projection, or crista sagittalis,

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corresponding to the sagittal suture. From here the parietal bones drop rather abruptly downward, or there may be a hollow on each side of the crest. The forehead is high and steep. The superciliary ridges, and the temporal ridges and depressions, are feebly marked. The orbits are very high and very shallow. The palate is often high and narrow. The face may be asymmetrical, due usually to a flattening or depression in the malar and submaxillary region.

The Röntgen picture is very striking (Figs. 3 and 4). The skull is usually thinned and marked by wave-like depressions, corresponding to the cerebral convolutions. The sutures are usually not seen. The base of the skull is deformed; the middle fossa is deepened so that it is almost on the same level with the posterior fossa; the sella turcica is widened and deepened; the great wings of the sphenoid are flattened out; the roof of the orbit may be almost vertical; the head sinuses are compressed and sometimes practically obliterated.

Exophthalmos with divergent strabismus is nearly always present in the well marked cases, though the strabismus is occasionally convergent. The exophthalmos is due to the very shallow orbits.

Nystagmus is very commonly present; it is usually bilateral and in all directions.

The impairment of vision is marked in nearly all the cases. The cause of this impairment has been discussed above. It may be present at birth but is usually noticed between the second and sixth years of life. It may progress to a certain degree and stop or go on to complete blindness.

The loss of smell is not infrequent. Hearing is sometimes dulled and the sense of taste is occasionally lost.

Oxycephaly may be associated with other congenital anomalies, but this is not strikingly frequent.

Treatment.—It is only in recent years that operative measures have been undertaken with the object of combating the symptoms of increased intracranial pressure, especially the threatened blindness.

Since most observers think that this increased pressure is due to the disproportionate growth of the brain and skull, decompression seems to be the operation of choice; moreover, it has the advantage of simplicity and relative safety. It should be done early, for in cases with irreparable optic atrophy and no other pressure symptoms operation is not indicated. The results of this operation in the small number of cases in which it has been done are distinctly encouraging, in spite of the fact that the optic atrophy was rather advanced in most instances. In 1916 Sharpe reported four cases of oxycephaly in which he had done subtemporal decompression, unilateral in one, bilateral in three. The three cases in which the bilateral operation was done were followed and found to be greatly improved; the other case could not be traced.

The case, here reported, in which I did a bilateral subtemporal decompression, was seen about two years after this operation. The parents

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stated that his general condition was much better and that he seemed to see better, as he stumbled much less in walking. He could count fingers at three feet, which he could not do before operation. Examination of the eye grounds, however, showed practically no change, there being a marked optic atrophy in both eyes. An interesting feature of this case is that at operation the bulging of the brain was so marked that the temporal fascia could not be at all approximated on either side, therefore the defects were covered by transplanted patches of fascia lata. Another point of interest is the ossification of the tissues over the region of the decompression, this bone showing the same digital impressions as the rest of the skull (Fig. 5).

Considering the increased intracranial pressure to be due to internal hydrocephalus, Bramann and others have advised puncture of the corpus callosum in oxycephaly, but, as stated above, internal hydrocephalus seems rarely present in such cases. When doing a decompression we certainly would not omit a ventricular puncture if we have reason to suspect that internal hydrocephalus is present.

The "Kanal operation" of Schloffer does not appeal very strongly to us, but it might be justifiable in certain cases, when a decompression has failed to improve the condition of the optic nerve.

REPORT OF CASES

The first case is a typical case of oxycephaly which was admitted to the University of Virginia Hospital with advanced optic atrophy. The second case is certainly not typical, but I think it is a case of cranial stenosis, probably of the "turmschädel" type. The head is quite tall and the skiagram of the skull shows many of the characteristics of the steeple head skull, but a marked anterior staphyloma in both eyes prevented my examination of the optic disks.

CASE I.—T. W., colored male, aged four years, was admitted to the hospital February 11, 1918, complaining of failing vision.

Family History.—Father, mother, two sisters, and one brother living and in good health. No history of abnormalities in family.

Previous History.—Patient is the third child. His birth was not difficult. Had whooping cough at nine months of age, after which mother thought eyes were more prominent than before.

Present Illness.—Four months ago mother noticed that there was some trouble with the patient's sight. He seemed to be constantly running into things. Since then he has been getting worse. Mother says head has always been peculiarly shaped. There has been no headache, no vomiting, no convulsions.

Physical Examination.—The boy is well nourished and mentally bright. Head: Unusually tall (Figs. 1 and 2). Transverse diameter compressed in biparietal region. Forehead very high. Protrusion at bregma 4 by 6 cm. in diameter (crista sagittalis). Anterior

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and posterior fontanelles firmly closed. Supraorbital ridges are almost obliterated.

Skiagrams of skull (Figs. 3 and 4) show all the characteristics of the oxycephalic skull as described above. The "digital impressions" are unusually well marked.

Cranial Measurements: Hat circumference, 48.5 cm.; bimeatal arch, 35 cm.; chin to nasion, 11 cm.; width of orbit, 3.5 cm.; height of orbit, 4 cm.; inter canthi, 3 cm.

Face: Symmetrical.

Eyes: There is marked exophthalmos. Left eye shows internal strabismus. There is a marked impairment of vision, shown by the fact that he is unable to recognize familiar objects. He walks in a wandering fashion with a tendency to feel his way and often stumbles on things. The light reflex is present. Ophthalmoscopic examination shows marked bilateral optic atrophy.

Nose: Negro type, flat and wide. Septum is deflected. Sense of smell normal.

Mouth: Palate rather high. Tonsils very large.

Ears: Low placed, but normal in shape. Hearing normal.

Heart, lungs, and abdomen: Negative.

Extremities: Negative. No evidence of rickets. Motion and sensation normal.

No other abnormalities of any kind made out. Wassermann test negative.

Operation (February 16, 1918).—A bilateral subtemporal decompression was done. Temporal muscles very thin. The skull was extremely thin, in fact, almost as thin as paper, and at one point on the left side there was a definite opening 5 mm. in diameter, due to pressure atrophy. Openings the size of a silver dollar were made on each side of the skull and through these openings there was a very marked protrusion of dura and brain. The dura was not opened. An attempt was made to suture the temporal fascia but it could not be brought together, so patches of fascia lata 4 to 5 cm. in diameter were transplanted to cover defects and sutured with fine silk. The wounds healed per primam and patient made an uninterrupted recovery from operation.

He returned for examination on December 5, 1919. Mother says his general condition is much better and she thinks he can see better, as he stumbles much less in walking.

He can count fingers at three feet with the right eye and with the left eye he can see movements of the hand at three feet, which is a distinct improvement over vision before operation, but examination of the eye grounds shows no improvement. There is advanced optic atrophy, the disks being white and indistinct in outline.

Examination of head shows protrusions, 6 cm. in diameter and 1 cm. high, in region of decompression. Protrusions are covered with bone as shown by X-ray photograph (Fig. 5).

CASE II.—T. A., colored female, aged about four years, was ad-



FIG. 1.—Case I. Note very tall, narrow head. Exophthalmos.



FIG. 2.—Case I. Lateral view. Protrusion at tregma. Relatively short face.



FIG. 3.—Case I. Anterior-posterior skiagram. Note thin skull and "digital impressions."



FIG. 4.—Case I. Lateral skiagram. Note deep middle fossa, shallow orbits and obliteration of mastoid and frontal sinuses.



FIG. 5.—Case I. Two years after subtemporal decompression. Note ossification over decompressions

OXYCEPHALY: REPORT OF TWO CASES

mitted to the University of Virginia Hospital, September 23, 1919, complaining of sore eyes and loss of sight.

Family History.—Father living and well. Mother has had "epileptiform attacks" for eight to ten years. No brothers or sisters.

Previous History.—Mother had a very stormy time at patient's birth, was in labor for several days and was delivered with forceps. No disease of childhood except whooping cough.

Present Illness.—Several days after birth mother noticed "corruption" in child's eyes and some days later she noticed a whitish covering over the eyes. This opacity and the bulging of the eyes have gradually grown worse and about five months ago the left eye "burst." Mother has not noticed any peculiarity in the shape of the head. There has been no headache, no vomiting, and no convulsions.

Physical Examination.—Child is fairly well nourished. Mentality is good, especially considering the deprivation of vision.

Head: The tall head and high forehead are striking, but there is no protrusion at the bregma. The union of the cranial sutures is apparently normal. No ridges along cranial sutures. The supraorbital ridges, and the temporal ridges and depressions, are feebly marked.

Skiagrams of skull show it to be unusually thick and "digital impressions" are not marked except in lower portion of the parietal and in the temporal bones, but middle fossa is wide and deep and is only slightly above the level of the posterior fossa. The head sinuses are almost obliterated. The orbits are high and shallow.

Cranial Measurements: Hat circumference, 48 cm.; bimeatal arch, 34.5 cm.; biparietal diameter, 13 cm.; bitemporal diameter, 12.5 cm.; width of orbit, 3.1 cm.; height of orbit, 3 cm.

Face: Symmetrical, comparatively small for the cranium.

Eyes: Slight exophthalmos is noted with divergent strabismus, more marked in left eye. Nystagmus is present, bilateral and in all directions.

Owing to the anterior staphyloma, resulting from gonorrhoeal ophthalmia, examination of the eye grounds is rendered impossible and we cannot determine whether optic atrophy is present. Vision in both eyes is practically destroyed, large objects, light and dark, only being perceived.

Nose: Negro type. Septum not deflected. Sense of smell normal.

Ears: Placed very low but normal in shape. Hearing normal.

Mouth: Palate quite high and narrow.

Heart, lungs, and abdomen: Negative.

Extremities: Negative. No evidence of rickets. Motion and sensation normal. No other abnormalities of any kind made out. Wassermann test negative.

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THE SURGICAL TREATMENT OF CYSTS OF THE THYROGLOSSAL TRACT *

BY WALTER ELLIS SISTRUNK, M.D.

OF ROCHESTER, MINN.
MAYO CLINIC

VERY early in fetal life the thyroid gland develops at the base of the tongue and, before the cartilage of the hyoid bone has formed, descends in the midline of the neck to its normal position. The epithelium lining this tract through which the thyroid descends normally disappears early in fetal life, although it occasionally fails to obliterate and in such instances isolated areas of thyroid tissue (aberrant thyroids) or cysts may develop along its course. It seems quite likely that the portion of the tract lying above the hyoid bone often retains its epithelium and patency and opens directly into the mouth through the foramen cæcum near the base of the tongue. A persistence of this portion of the duct explains the development of cysts along this tract which do not appear in young children but are first noticed a number of years after birth. In such instances it is probable that any secretion which developed from the epithelium-lined tract emptied directly into the mouth through the foramen cæcum, and that at some time infection occurred in the duct and closed the opening into the foramen cæcum. Any fluid accumulating in this duct after the opening in the foramen cæcum has become blocked, most likely travels downward, following the tract made by the descending thyroid, and presents itself as a tumor in the midline of the neck near the hyoid bone.

In 86,000 consecutive patients examined in the Mayo Clinic only 31 thyroglossal cysts were found. Eighteen of these were in males and 13 in females. The cysts appeared at all ages from birth to fifty-three years, the majority being noted in patients between the ages of twenty and twenty-five years. In 25 of these patients the cyst was found in the midline of the neck, near the hyoid bone.

The diagnosis of such cysts is usually not difficult and is made by the finding of a rather firm, cystic tumor in the midline of the neck, near the hyoid bone or the thyroid cartilage. When this is palpated the duct which runs from the cyst to the hyoid bone may usually be felt. If the cyst is left alone, it gradually enlarges and often is drained surgically. In other cases infection occurs within the cyst and an abscess forms which also is often opened and drained. In either case a sinus remains which discharges the fluid secreted by the epithelium lining the tract. In many of the patients whom we have examined fistulas have been present which had persisted for periods varying from six months to twenty-nine years.

The majority of operations for the cure of thyroglossal cysts are unsuccessful unless the epithelium-lined tract, running from the cyst to the foramen cæcum, is completely removed. As a rule, the cyst and the portion of the tract lying below the hyoid may be dissected out without difficulty, but above this the tract is usually so small and friable that it is broken off easily and consequently is difficult to remove. We have learned, after having failed to cure certain patients in whom the duct was broken off between the hyoid bone and the foramen cæcum, that better results are obtained when no attempt is made to isolate the duct above the hyoid bone. Instead of attempting this, the usual procedure, we remove with the duct the tissues surrounding it for a distance of about one-eighth of an inch on all sides, coring out, as it were, the tissues between the hyoid bone and the foramen cæcum in a line, which the tract almost invariably follows, drawn at an angle of forty-five degrees from the upper surface of the centre of the hyoid bone in the midline of the neck, backward and upward, toward the base of the tongue (Figs. 1 and 2).

The operation we usually perform is as follows: A transverse incision, about two inches in length, is made across the neck at about the level of the hyoid bone and the skin and platysma muscle are reflected. The cyst will be found lying beneath the raphé connecting the sternohyoid muscles. It is dissected free from the surrounding tissues up to the hyoid bone. At this point the tract usually passes through the hyoid bone, although it is sometimes found passing above or below it. We then separate the muscles attached to the centre of the hyoid and remove a portion of the bone about one-fourth of an inch in length; then, without any attempt to isolate the duct, we core through the tissues from this point directly to the foramen cæcum, removing with the duct the tissues surrounding it for a distance of about one-eighth of an inch on every side (Fig. 3). In order to do this, it is necessary to know very accurately the direction that must be followed in order to reach the foramen cæcum. This line corresponds to one drawn at an angle of forty-five degrees backward and upward through the intersection of lines drawn horizontal and perpendicular to the superior central portion of the hyoid bone. The dissection removes with the duct a portion of the hyoid bone, a portion of the raphé joining the mylohyoid muscles, a portion of each geniohyoglossus muscle, and the foramen cæcum. The opening into the mouth is closed and several sutures are used to draw the geniohyoglossus muscles together; the tissues surrounding the cut ends of the hyoid bone are then brought together with chromic catgut sutures in such a manner as to approximate the edges of the bone. A small rubber tissue drain is introduced down to this point and the skin closed around it. It is probably best to inject sinuses with some dye, such as methylene blue, in order that any lateral branches, and these are occasionally found, which may be present between the hyoid bone and the foramen cæcum may be recognized and removed. We have never seen ill effects follow the removal of a portion of the hyoid bone, nor have we ever seen infection of a serious character follow the opening made into the mouth.

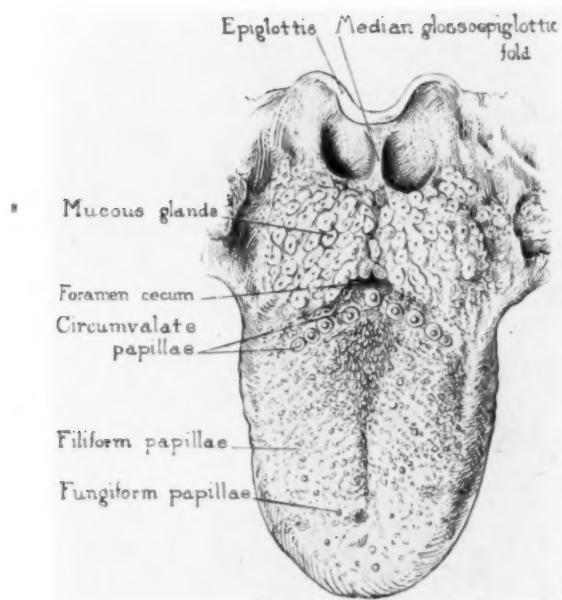


FIG. 1.—Anatomy of the dorsal surface of the tongue and the position of the foramen cæcum.

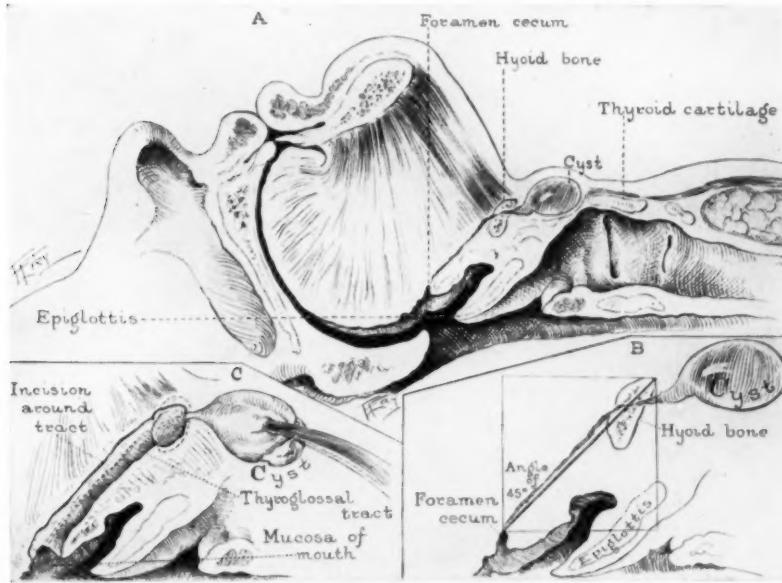


FIG. 2.—A. Sagittal section of the head giving the usual direction of the thyroglossal tract. The cyst is shown presenting between hyoid bone and thyroid cartilage. B. Dissection of duct to be made along an imaginary line drawn at an angle of 45° from the intersection of lines drawn horizontal and perpendicular to the middle of the anterior superior portion of the hyoid. C. The duct with muscles surrounding it being "cored out" along the line shown.

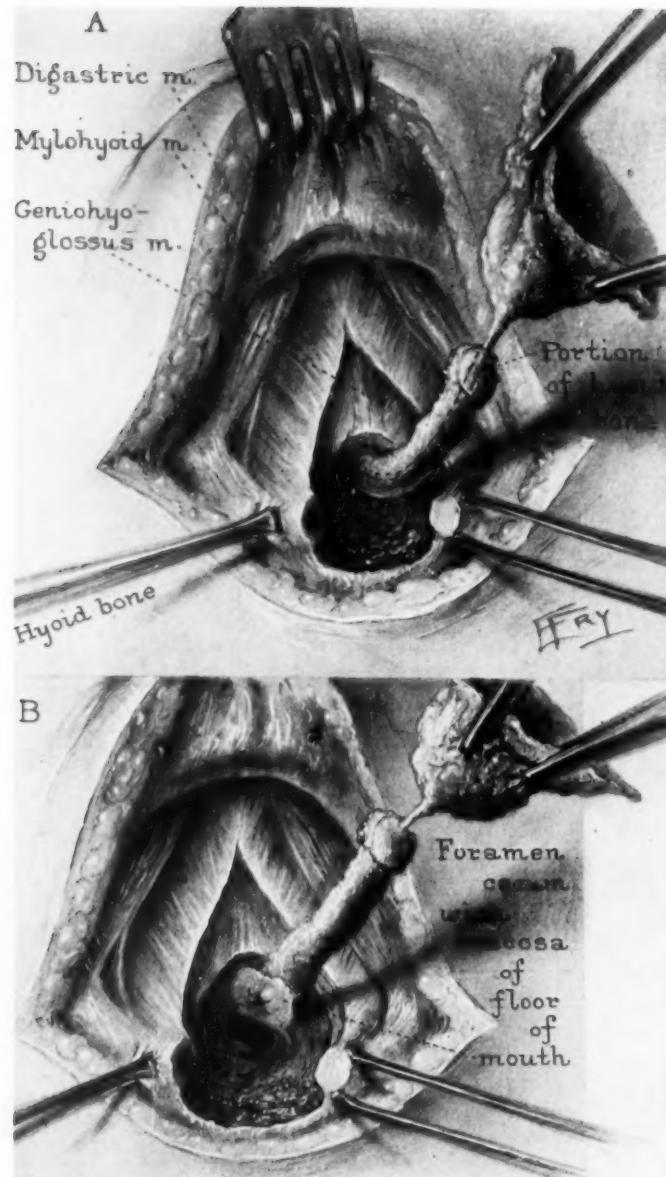


FIG. 3.—Steps of the operation. A. A segment of hyoid has been removed and the duct with the surrounding tissues is being dissected out. B. The dissection has been extended through the tongue; the foramen cæcum may be seen.

STONE IN THE KIDNEY *

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IN medical progress the means of relief by therapeutic measures or surgery have far outstripped our knowledge of the cause of disease. The etiology had been proved in a sufficient number of instances, however, and reasoning by analogy in other diseases had led to measures of prevention and control of many of the common ailments before the identity of the bacterial agents was known. Medicine is in its most interesting phase, namely, a consideration of the etiology which carries investigation into the field of biochemistry, the newer physiology, and like sciences. The philosophic view of bacteria is to consider them necessary to life as the minute chemists of the air, the water, and the soil. But few of their countless numbers are the cause of disease by being misplaced in their activity and only a small number, possibly, are natural disease-creating organisms.

THE FORMATION OF STONE IN THE KIDNEY

Crystalloids probably form in the structure of the kidney, the cortex, and the surface, without local infection, the result of a rare unbalanced contest constantly ensuing between crystalloids and colloids. Stones in the kidney, ureter, or bladder undoubtedly originate in the kidney, except those which develop from foreign bodies in the bladder. The cause of stone in the kidney has long been a subject of discussion; the old and simple theory that they grew like Topsy, is no longer satisfactory, and some of the other theories that have been advanced, although most interesting, are not generally accepted. An acceptable scheme of stone formation must be applicable to the several regions in which stones are found and it must not differ materially for any locality. Morris considers two types of stone, the first due to urinary salts or ingredients precipitated from the urine in the kidney, independent of any change in that structure or of infection, and the second, to precipitation due to chemical changes caused by microorganisms. An analysis of stones in the Hunterian Museum has shown a urate nucleus in stones formed in infancy, a uric acid nucleus in stones removed from young adults, and an oxalate nucleus in stones removed from patients in middle life.

Two-thirds of the kidney stones giving trouble are found in patients in the third and fourth decades, although the stones appear in every decade of life. Certain observers hold to the theory that a slowing of the delivery of urine in limited areas leads to increased concentration and deposit of salts. In denying the infection theory they call attention to

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the fact that renal stones are more often found in men than in women, although the female genito-urinary tract is more likely to be infected. According to their theory, therefore, an increased number of stones should form following mechanical interferences in areas of the pelvis with the passing of urine, such as partial ureteral obstruction, and extraneous pressure, glands, tumors, or pregnancy, for instance; but this does not appear to be the case. Hunner's theory is not generally accepted, that the over-saturated urine forms stones which originate in the ureter above a stricture of large calibre and may float back into the pelvis of the kidney. It is barely possible that the infection causing stricture may be furnishing mucoid, the cause of stone formation in such a condition. If these hypotheses were true, the number of cases of stone from such causes would be greatly added to by the partial compression of anomalous vessels acting on the ureteropelvic juncture in unusual mobility of the kidney, first shown by W. J. Mayo and later by Rupert to be a very common condition.

Stones are frequently found in both kidneys. Braasch found bilateral lithiasis in 12.3 per cent. of 450 cases of nephrolithiasis. Many patients with stone in the kidney have no pain, and 65 per cent. with stones in both kidneys have pain on one side only. Cabot, by means of repeated tests, showed that there are no abnormal urinary findings in 14 per cent. of the cases of stones in the kidney and ureter. The kidney is an organ of filtration and is constantly eliminating bacteria from the circulation. These are many in variety and, without some contributing circumstances, apparently do not injure the urinary tract in their passage through the kidney, ureter, and bladder any more than bacteria on the skin or those passing through the alimentary tract or normally living there cause trouble in those regions. Some types of bacteria produce infarctions in minute clumps of capillaries, and following surgical conditions gross kidney infarctions and infection which cause death are occasionally seen. The minute haemogenous infections at the boundary of the terminal circulation in the cortex of the kidney at its juncture with the tubules are seldom extensive enough to create more of a change in the patient's general health than an acne pustule on the face. The eliminating surface of the kidneys probably equals that of the skin covering the body, but the latter has the power of cell growth given to epithelium for restoration as an additional protection. The infection theory seems the only tenable one, but I contend that the development of stone requires the presence of two factors of infection, that is, two types of bacteria, one producing the haemogenous infection, and one only coming from a local focus; the second may but temporarily inhabit the blood in the process of elimination. Bacteria of the stone-forming type must come in contact at the proper time, a brief period only, in which the mucoid exudate is present as a result of the first infection.

It seems hardly possible that the lime content of food or drink, which



FIG. 1.—Infected hydronephrosis with multiple nephrolithiasis.



FIG. 3.—Coral-shaped stone with hydronephrosis of the kidney.

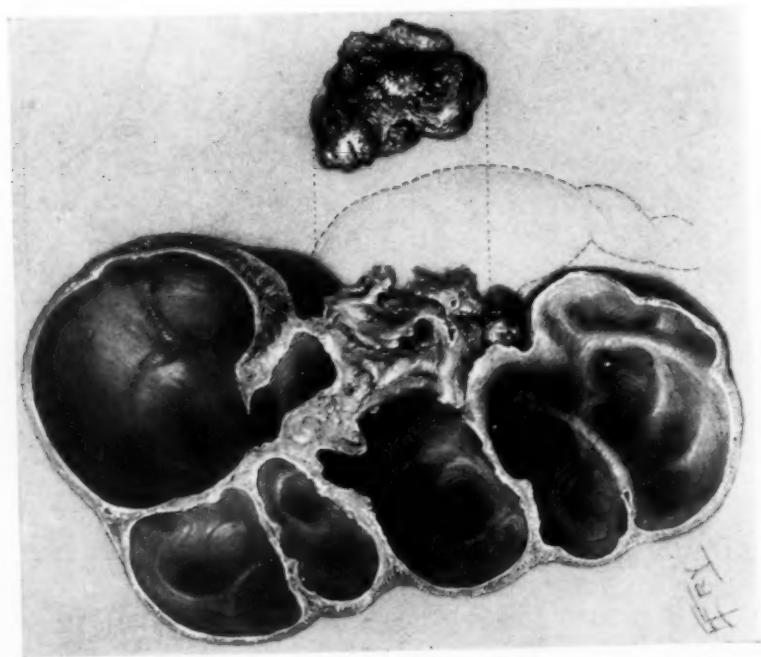


FIG. 2.—Hydronephrosis with oval stone.

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it must be admitted varies greatly, has very much to do with the origin of stone, although it might influence the rapidity of the growth of the stone. The origin of stone in the kidney is no more mysterious than that of stone on the teeth of infected mouths, which requires a chisel and hammer for removal; saliva resembles the mucoid, giving foothold through diseased gums for types of bacteria of the proper strain, and stone formation ensues; this is true also in the development of gall-stones, which form only in an infected gall-bladder. A step further is the development of the shells of the fresh and salt water mollusks. We think of them as having been built by the mollusk; in reality they are built by bacteria feeding on the pabulum of his exuded mucoid material, according to which the natural type of shell is constructed from the solutions held in the water of the sea or river, the bacteria doing the work for bed and board, the mollusk furnishing the muscle hinge. If these bacteria become misplaced within his body a pearl or slug develops as the result of his disease. Such life can be reproduced only in limited areas of sea or river beds where the bacteria grow in great numbers, producing clam and oyster beds. The work done by such bacteria is no more important than that of the insects which fertilize the fruit flowers.

Stones form in the cortex, in the calyces, and in the pelvis of the kidney. The kidney is constantly eliminating living bacteria, so that it is always exposed to infection, and usually shows no results from it except gross lesions of rare occurrence. Stone formation may proceed with exceeding slowness and without pain or other symptoms until marked destruction of the kidney occurs, mixed infection develops, or until the stone assumes great size or becomes loosened and moves into the ureter (Fig. 1). Minute infarctions occur, as shown at necropsy following death from an acute attack, and the results of similar lesions in the past are shown by scars or gross kidney change.

Stone formation is evidently the result of the combination of two types of bacteria; the first creates an infarction with minute necrosis causing mucoid exudate; the second factor is the elimination at the same time of the stone-forming bacteria that they may come in contact with the mucoid material. If the stone originates in the cortex of the kidney its growth will be slow, but if it originates in the calyces or pelvis growth may be much more rapid because of the ease with which its chemical material is secured.

Stones in the kidney vary in chemical composition but are homogeneous; they are round, irregular, multiple or branched, coral-like (Figs. 2 and 3). Those forming or increasing in the urinary bladder often form rings of varying widths, as shown by cross-section. During growth stones are covered with mucous and the changes in structure probably have to do with the mucoid material on the stone or changes in the metabolic process, so that the structure varies with changes in the number of the workmen or the material supplied them. Bacterial types differ

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in their handling of material as much as masons differ in the use of brick, stone, and cement. It is of interest to note that young oysters transplanted from the shores of England to the Mediterranean oyster beds will have the ray shells formed by the new bacterial architects (see bibliography, Turnbull), a fact of importance in considering branched coral-like stones in the kidney. Medical treatment in principle is based on a change in the chemical conditions of urine or local environment created by food changes, by dilutions, or by elimination of various chemical bacterial detritus. In the review of a limited number of cases in which operation was done during the formative period of surgery of the kidney Cabot found that stone in the kidney reformed in 49 per cent., stone in the ureter in 29 per cent. Braasch, in a consideration of 450 cases of stone in the kidney in which operation was performed, showed that the recurrence was slightly under 10 per cent. We believe that this better result is due to more careful examinations made within the last few years, to the greater facilities for all kinds of tests, including röntgenography, especially after operation, in order to discover whether or not a stone has been overlooked; the röntgenogram occasionally shows surprising results in cases of small multiple stones. More careful search must be made for extra stones, since superimposed stones may give but one shadow.

The mortality is low in operations for the removal of stone in the kidney. The reports from the clinic (Table I) show that the mortality percentage has risen during the past three years over that of the years from January 1, 1898, to December 31, 1915; this is no doubt due to the greater risks which have been taken, but which have resulted in the saving of an increased number of lives.

TABLE I
Results of the Removal of Stones from the Kidney

	Number of patients	Number of operations	Deaths
January 1, 1898, to December 31, 1915	450	484	3 (.62 per cent.)
January 1, 1916, to December 1, 1919	487	499	8 (1.6 per cent.)
	937	983	11 (1.12 per cent.)

In closing, I wish to call attention to a plan devised by Doctor Braasch and Doctor Carman of the clinic to prevent overlooking stones in the kidney at operation and to facilitate search for small stones giving symptoms that are difficult to locate in the pelvis, the calices, or the cortex of the kidney. In the course of the operation the kidney is elevated into the incision, above the level of the skin if possible, where it is held by an encircling pack of gauze; a portable X-ray apparatus of the army type is moved to the side of the operating table and under the darkened glass and hood the röntgenologist is at once enabled to locate the stone and to point out the location with an aseptic glass rod, or, what is just as

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important, and occasionally occurs, he proves that the shadow seen in the röntgenogram was not due to stone in the kidney, and thus prevents serious injury to the organ by a fruitless search. The röntgenologist wears darkened glasses for fifteen minutes before attempting such an inspection. The operating room is darkened and the operator works under electric light which can be turned off and on.

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THE RESULTS OF OPERATIONS FOR THE REMOVAL OF STONES FROM THE URETER*

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WITHIN the past few years many ingenious non-surgical methods for the removal of stones from the ureter have been devised and described, thus greatly reducing the need for operation in these cases. It is first to be desired in cases of stone in the ureter that the stone shall pass voluntarily into the bladder. In some instances this will occur during the first attack of pain, although usually several attacks are required to force the calculus through. Without special investigation of this subject it may not be realized how many persons pass stones spontaneously. I have known of 12 per cent. of a group of about 400 persons to respond in the affirmative when they were questioned with regard to the passing of stones.

The published data and our own experience seem to show that most of these calculi originate in the calyces and in the kidney pelvis. In some of the cases in which there is an associated stricture of the ureter the stone may originate at the point of the stricture, as suggested by Rovsing and Hunner; in most of our cases, however, in which a definite, firm stricture was found there was no evidence of a calculus.

The symptoms produced by ureteral calculi are usually very definite and suggest the condition, even though in a number of cases the stone may lie in the ureter for a long time without any apparent changes or symptoms. In several such cases we have not seen changes of any consequence in the ureter or the kidney, nor evidence of interference with the passage of urine. In by far the larger number of cases the characteristic symptoms are manifest, but the syndrome must not be depended on for the diagnosis, since it may be misleading; a variety of other conditions may produce nearly the same syndrome and, furthermore, an accurate and dependable diagnosis can be made in nearly every case by the use of the X-ray combined with the opaque catheter and ureterogram, and in some cases the wax-tip catheter. In doubtful cases in which it is necessary to exclude the possibility of the X-ray shadow which is being produced by an extra-ureteral structure, Doctor Braasch employs ureterograms, and by this method has reduced the possibility of error to an inconsiderable degree.

When the diagnosis has been made and the exact location of the stone is determined there are several points to be considered regarding the plan to follow. We must first remember that in many cases the

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stones will pass of their own accord, so that if the patient is having frequent and severe attacks of pain it will probably be best to keep him under observation for a reasonable length of time in the hope that the stone may pass unassisted. During this waiting period, however, the possibility of too severe pressure in the ureter and kidney and of a permanent hydronephrosis or pyelonephrosis should constantly be kept in mind in order that this waiting time shall not be too prolonged. In cases in which the stone apparently is not causing symptoms, even when it is discovered in the course of a routine examination, its removal is advisable unless there is some contra-indication. In all the cases in which the stone does not pass readily of its own accord it is best to consider the non-operative methods of treatment.

Patients with stone in the ureter who come to the clinic for treatment are seen and examined in the department of urology. After the diagnosis has been made the non-operative methods are employed. Braasch, who has removed about 126 calculi in this manner, dislodges the impacted calculus by a ureteral catheter or a small sound. His results have been very satisfactory, and he believes that all patients should have the benefit of an attempt to remove the stones without operation. Braasch's definite contra-indications to further attempts to dislodge stones are: (1) A stone 2 cm. or more in diameter; (2) acute ossification with continuous obstruction; (3) acute renal infection; (4) the patient's intolerance to cystoscopic manipulation, and (5) anatomic deformity. If the renal infection is severe intra-ureteral methods should not be attempted, and the operation should be undertaken with the idea that it may be necessary to remove the kidney.

The results of non-operative methods depend largely on the manner in which they are used. Braasch has obtained excellent results by dislodging stones with ureteral catheters and he has also had some good results with papaverin. In nearly all the cases in which the stone presents at the ureteral orifice he has succeeded in removing it by means of the Bransford Lewis and other types of instruments. It is difficult to decide just how many times these non-operative measures should be repeated; the success of the attempt and the pain and discomfort to the patient may well be deciding factors. In some cases, undoubtedly, such treatments have been carried too far, producing infection in a normal kidney, and considerable trauma to the ureter and bladder. It should be borne in mind that while this non-operative treatment was being perfected many improvements were made in the surgical treatment, and the results of operative procedures are now very satisfactory.

A stone lodged in the ureter may result in pathologic changes in several different tissues. In many cases the ureter is dilated above the stone and in some instances this dilatation is marked, so that the ureter seems almost as large as the small intestine. In such cases the wall of the ureter is thick, with definite signs of inflammation. At times the stone com-

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pletely blocks the ureter and there is an accompanying hydronephrosis. Unless the kidney is extensively infected it need not necessarily be removed, since after the stone is removed sufficient renal function may remain to warrant saving the kidney. The same condition may result whether the stone is large or small. Contrary to this is the case in which the ureter, on exposure, appears normal in size and appearance, a condition noted in many of our cases. The stone seems almost to fill the lumen of the ureter, and yet there is no dilatation and no evidence to show that the ureter has previously been dilated. The improbability that these stones descend through the apparently normal ureters seems to be evidence of the fact that some of these calculi may form in the ureter itself, possibly at the site of a stricture. This type of stone is small and it is often difficult to locate it in a seemingly normal ureter. It is undoubtedly true that stricture of the ureter occurs in association with stone, and it is quite probable that in some of our cases in which there was not immediate complete relief of symptoms after the stone was removed a stricture caused the trouble. I have been impressed with the infrequency of any gross evidence of a stricture. Even in cases in which difficulty was experienced in removing an inaccessible stone and in those in which the stone had perforated the ureter and produced much peri-ureteral infection we have not seen a stricture of any consequence. In some of our cases there was delay in the closure of the urinary sinus, but in all the sinus was completely closed within a few weeks, and no permanent fistulas occurred. There must have been stricture in some of our cases, but I believe that in most instances the condition relieves itself.

The same conditions follow the removal of stone by the non-operative and the operative methods. In several cases we have found the ureteral calculus lying in an abscess cavity outside the ureter, and in all of these the condition was relieved by the removal of the stone from the abscess pocket and drainage of the abscess without any endeavor to manipulate the ureter. If a pyelonephritis has resulted from the stone and there is evidence of more or less general infection it is inadvisable, if there is a good functioning kidney on the opposite side, to remove the stone and establish drainage. In many of these cases the damage to the kidney is already beyond recovery, the immediate results will not be satisfactory, and the kidney will have to be removed later. In the extreme case, if the stone is in the lower third of the ureter so that a very large incision, or in some instances two incisions, would be required to remove the kidney and the ureteral stone, it is best to remove the kidney and leave the ureter and stone, removing the stone later if necessary. In two of our cases we were obliged to remove the calculus from the ureter at a later date because of pain. Before operation it may be impossible to determine the amount of function in the affected side, as it is sometimes impossible to collect the urine because of the presence of the stone. In these cases I believe the best plan is to remove the stone and preserve the kidney if

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we are not aware of infection in the kidney at the time. Conservative methods are justified in any case of chronic infection of the kidney, but radical methods must be employed in acute severe infection, and nephrectomy should be done before severe uræmia and toxæmia threaten.

In two of our cases complete anuria was produced by stone in the ureter. In Case I (A195194) the patient had been operated on by Dr. W. J. Mayo five weeks before for hypernephroma of the left kidney. The patient made an uneventful recovery from the nephrectomy, was discharged from the hospital, and was about to leave for home when he noticed that his urine had diminished greatly. He told of having passed stones, probably from the right side, some time before, and of having colic, which suggested a stone on the right side. Finally the urine stopped completely and treatment was instituted for suppression, but aside from the fact that there was a little evidence of oedema the patient did not appear to be sick. Doctor Crenshaw catheterized the right ureter and met an obstruction about 5 inches from the bladder which the X-ray showed to be a stone. The patient had passed no urine for six days when I operated, removing the stone from his right ureter. The ureter was greatly dilated and filled with turbid urine. The kidney started to functionate apparently as soon as the pressure was relieved, a large amount of urine was secreted, and the patient made a complete recovery.

In Case II (A205789) the man gave a history of having been operated on several months before for stone in the left ureter. He came to the clinic because of a persistent urinary sinus through the scar on the left side. Doctor Braasch's examination revealed a stone in the right ureter about 6 inches from the bladder, and a ureteral catheter was passed to the scar of the operation on the left ureter. The patient was passing about equal amounts of urine from the bladder and the sinus in the left flank. Shortly after the examination the urine stopped completely. We tried again to probe the urinary sinus on the left side but were not successful. For six days there was no urine passing from the sinus or the bladder and yet the patient apparently was having no trouble because of it. I then removed a stone from the right ureter which was greatly dilated and filled with turbid urine as in Case I. Because of the evident infection no effort was made to close the opening in the ureter and the urine drained for several days, after which the wound healed completely. At this time the sinus on the left side, which we had not been able to open with a probe, opened spontaneously and drained urine. A month after removing the stone from the right side, I operated through the scar on the left side, and closed the left ureter, which was greatly scarred and thickened. Examination of the ureter revealed no cause for the persistent sinus and trouble except extension of scar tissue and stricturing. I excised much of the scar tissue and reconstructed the ureter over a small tube, which was pushed down the ureter so that it projected into the bladder. The tube was removed some days later by means of the

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cystoscope. The sinus did not reform and the ureter was patent at the time the patient was discharged.

The most striking feature in both these cases is that, in spite of the fact that no urine escaped for six days, the patients did not appear to be sick.

In our few cases of bilateral ureteral calculi, it has seemed best to remove the stones by operation rather than by non-operative methods. We usually operate on one side at a time, although in some instances we have removed stones from both ureters at one operation. The side showing evidence of acute trouble is operated on first; if there is no apparent difference we prefer to remove the stone from the ureter on the side having the best function.

The cases in which operation has been done between the years 1901 and 1918 are tabulated in Tables I to XIV. During this same time, Doctor Braasch has removed ureteral stones in about 126 cases by non-operative methods. During the same period we operated on 400 patients. In our earlier cases no attempt was made to remove the stone by non-operative methods. We find it is difficult to estimate just what percentage of ureteral calculi may be removed by non-operative methods, but probably the percentage is often given too high. Roughly estimated, I should say that at the present time about one-half the patients require operation in order to rid them of the stone; in other words, they will be better off if the stone is removed by operation.

Forty-eight (12 per cent.) of the 400 patients operated on had passed stones or gravel before operation; in 9 cases multiple stones, averaging 6, had been passed, but in all these cases impaction of a stone in the ureter necessitated operation.

The diagnosis of ureteral stone by X-ray and cystoscopy has been developed almost altogether since 1901, so that a much higher percentage of accuracy in diagnosis will be found in the later cases than in the cases of earlier years.

Our study shows that the results of operations for the removal of stone in the ureter have been almost universally satisfactory. Of this series of 400, two of the patients operated on have died and only one of these deaths could be attributed to the operation. In the first case an infected appendix was removed; the patient had a left hydronephrosis and a right-sided nephritis; he died of peritonitis. In the second case death resulted at about the end of two weeks from infection and extravasation of urine.

Convalescence following the operation is usually short and not attended by any difficulties. In some instances the urine drains freely for several days, and in others, even though the opening in the ureter has not been closed, there will be very little, if any, drainage. In the non-infected cases in which it is feasible to close the opening in the ureter, the wound heals primarily.

During the past few months, Doctor Scholl has made a careful review

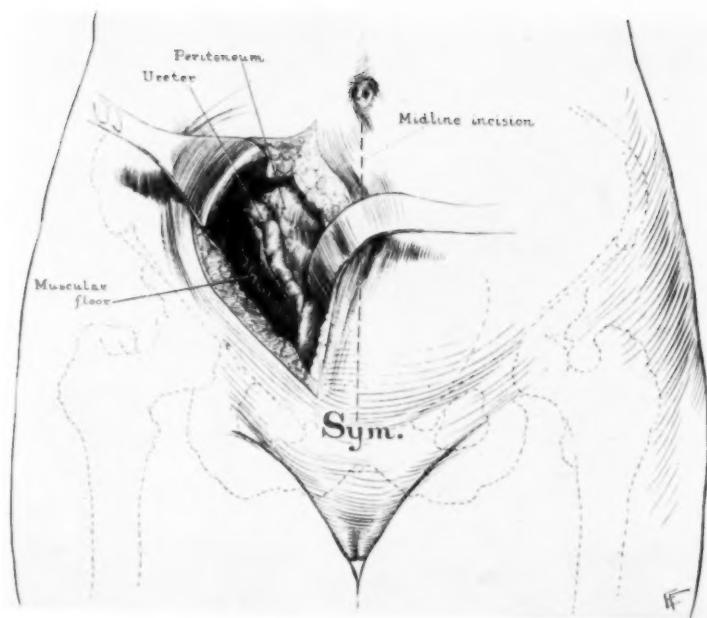


FIG. 1.—The midline incision is used when it is necessary to explore both ureters.

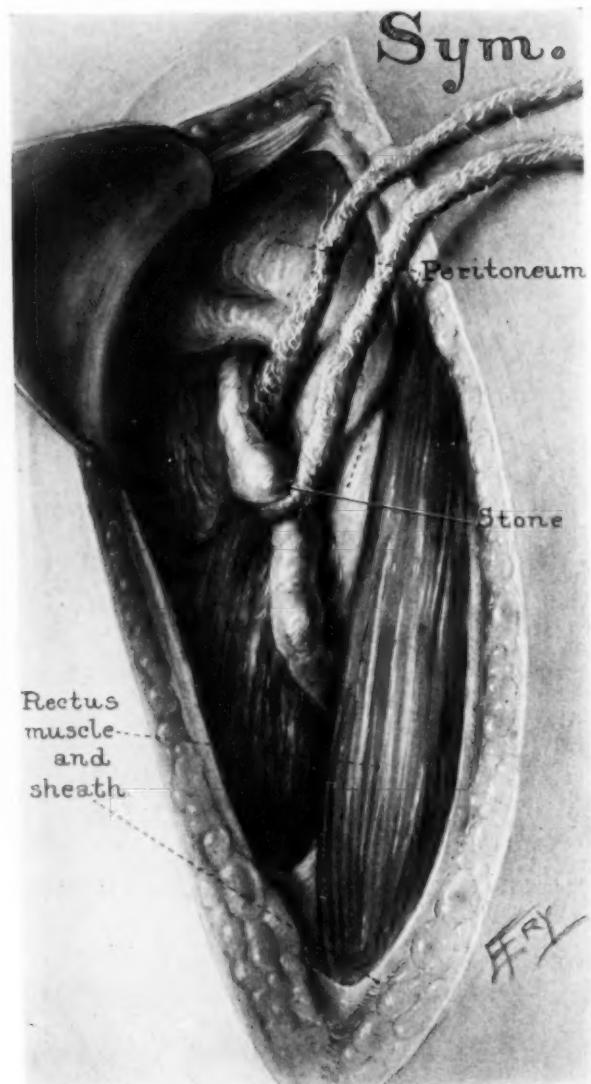


FIG. 2.—Isolated ureter containing a stone.

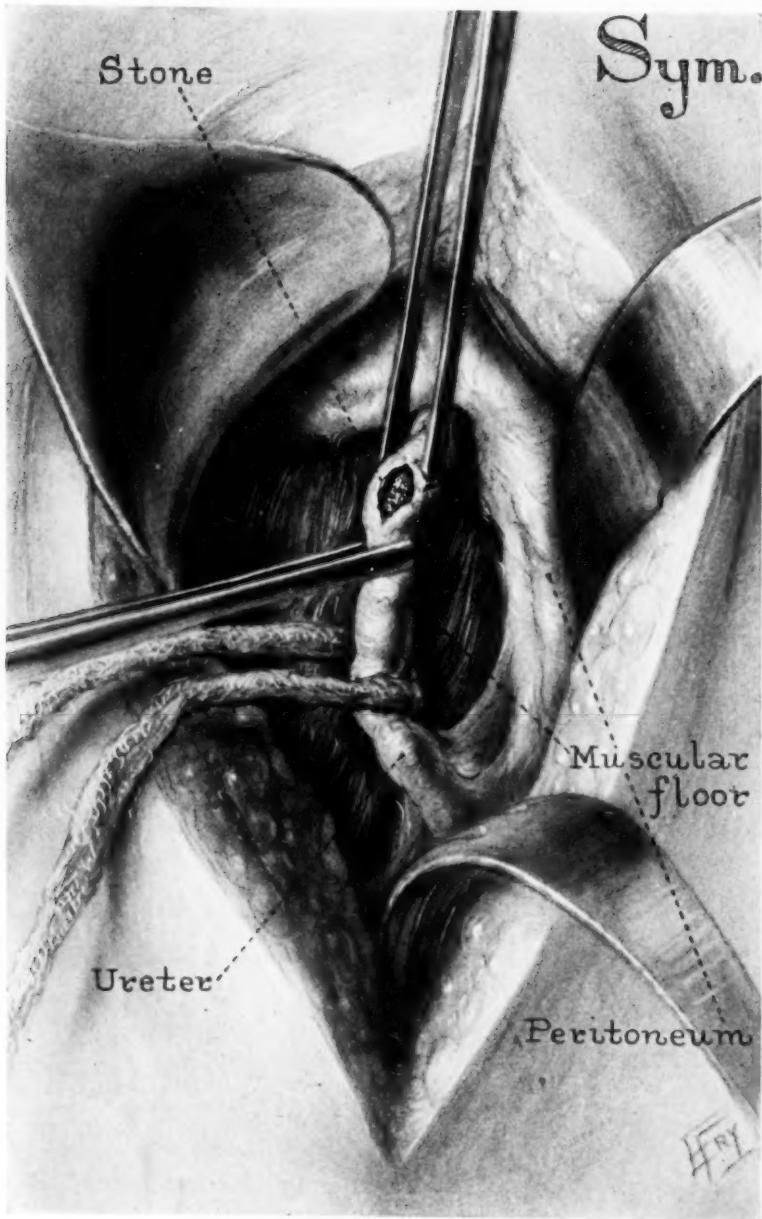


FIG. 3.—Incision in ureter showing a stone.



FIG. 4.—Interrupted catgut sutures being placed to close incision in ureter. Sutures do not pass through mucosa.

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of the histories of these cases, and has sent out "follow-up" letters to all the 400 patients, and answers have been received from nearly 300. In approximately 90 per cent. of these complete relief of former symptoms had ultimately resulted. A number of the patients mentioned the fact that they had pain in the same side and of the same character persisting for several weeks after the operation, but in most instances by the end of six months the pain had entirely disappeared. Twenty-one patients had pain severe enough at some time or other to require morphia. About 15 per cent. of the patients complained of frequency, and some of them of haematuria lasting for several weeks after the operation, thus showing that the infection which existed at the time of operation had a tendency to clear up later. Twenty-six of the 400 patients have passed stones since the operation. Of course, it is impossible to say whether these stones came from the kidney, the ureter on the side operated on, or the opposite side.

The technic of the operation for the removal of stone from the ureter differs according to the location of the stone. If the stone is situated at the uretero-pelvic juncture, or at any place in the upper third of the ureter, the best approach is through the Mayo posterior-lateral incision, the same incision as employed to explore the kidney. If the calculus is situated in the lower two-thirds of the ureter, the straight rectus incision gives the best exposure, the exact position of the incision depending on whether or not the calculus is in the middle or lower third of the ureter. Under ordinary circumstances the operation should be performed without opening the peritoneum, since less opportunity is allowed for infection. If the peritoneum is accidentally opened it should cause no alarm, although care should be taken accurately to close it. Since the retroperitoneal space is opened by retracting the peritoneum away from the posterior muscles, the ureter will probably retract with the flap of peritoneum, so that the search for the ureter should be made on the posterior surface of the peritoneum and not on the anterior surface of the muscle. If the stone is large the ureter is usually readily located by palpation. The greatest difficulty arises in locating a small stone in the lower end of a non-dilated ureter; fortunately this is the type of case most often relieved by conservative methods. Several years ago I called attention to a technic for exposing this part of the ureter and removing such stones. The operation consists in complete exposure of the lower end of the ureter in the manner employed in operating on the bladder for neoplasm or diverticulum. The entire lower third of the ureter is brought into view. After the stone has been removed it is best, I believe, loosely to close the opening in the ureter. Since Abell reported the series of cases in which he employed this technic I have used it many times without any ill effects, and I am sure that it has made convalescence much easier and shorter. The ureter has not healed in all cases without some drainage, but it has in many, and in others the urinary drainage was very slight.

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Stitching the ureter without penetrating the mucosa seems to be of distinct advantage.

CONCLUSIONS

1. The study of this series of 400 patients operated on for ureteral stone and the 126 patients treated by Braasch leads us to conclude that before instituting any method of treatment for the removal of stones from the ureter, it is well to bear in mind that a large percentage of such stones pass voluntarily; in the early cases, therefore, it is best to delay treatment.
2. Unless there are definite contra-indications to non-operative treatment for the removal of the stones, an attempt should be made to remove them by non-operative methods. We doubt the advisability of attempting to remove stones from the middle and upper third of the ureter in this manner, but, believe that with the development of the method nearly all small stones may be removed from the lower end of the ureter without operation.
3. While the operation for the removal of calculi from the ureter must be considered a major operation, it may be performed with practically no mortality and with universally good results. Therefore, if there is a definite contra-indication to non-operative treatment or if progress is not being made by such treatment, the stone should be removed by open operation without hesitation.

TABLE I
*Patients with Ureteral Stones Operated on at the Mayo Clinic
1901-1918 inclusive*

Total number	400
Males	248
Females	152
Location :	
Right ureter	197
Left ureter	195
Bilateral involvement	5
Not stated	3

TABLE II
Age at Onset of Symptoms

	Cases
0-10 years	10
10-20 years	38
20-30 years	129
30-40 years	125
40-50 years	61
50-60 years	25
60-70 years	8
Average age	32.4 years

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TABLE III
Age of Patients on Entry to Hospital

	Cases
0-10 years	4
10-20 years	5
20-30 years	87
30-40 years	135
40-50 years	108
50-60 years	42
60-70 years	12
70-80 years	2
Average age	37.7 years

TABLE IV
Duration of Symptoms

	Cases
1 year	138
2 years	60
3 years	27
4 years	23
5 years	22
5-10 years	62
10-15 years	33
15-20 years	19
20-30 years	11
Average duration of symptoms.....	4.8 years
Patients entering hospital after symptoms of one year's duration	34 per cent.
Patients entering hospital after symptoms of two years' duration	49 per cent.

TABLE V
Pain Referred To

	Cases
Region of kidney	281
Right loin	123
Left loin	142
Both sides	16
Lower abdomen	55
Right	33
Left	22
Suprapubic region	5
Upper abdomen	63
Right	34
Left	27
Epigastric region	2
Genitals	5

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TABLE VI
Bilateral Kidney Pain

	Cases
Stone in opposite ureter also	4
Stone in opposite kidney also	5
Pyelonephritis on opposite side	1
Not determined	6

Gross Hæmaturia

71 cases	17.4 per cent.
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Bladder Irritability

129 cases	32.1 per cent.
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TABLE VII

Urinalysis

	Cases
Pus	102
Blood	39
Pus and blood	191

332 (82.6 per cent.)

TABLE VIII

X-ray Findings

	Cases
Positive	295 (60 per cent.)
Negative	36 (9 per cent.)
Negative in 1919	11 (5.7 per cent. of 193)

Cystoscopic Findings

	Cases
Definite obstruction to ureteral catheter ..	240 (60 per cent.)
No obstruction	109 (27.2 per cent.)
Stone visible at meatus	1 (1 per cent.)

TABLE IX

Previous Operations

	Cases
Ureteral stone, same side	3
Ureteral stone, opposite side	1
Renal stone same side	4
Renal stone opposite side	1
Negative renal exploration, same side	3
Negative renal exploration, opposite side	1
Nephrectomy, opposite side	5
Nephrectomy, same side	2
(Nephrectomy was done five and seven years before, but stone was left in the ureteral stump.)	
Bladder stone	2
Appendectomy	54
Other abdominal operations	68

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RESULTS OF REMOVAL OF STONES FROM URETER

TABLE X
Negative Explorations

	Cases
Stone found in bladder	5
Definite signs of stone found at operation (stone had probably passed before operation)	3
Stone passed one month after operation with definite renal colic (Stone probably in ureter but not located)	1
Probable mistaken diagnosis	4
Mistaken diagnosis in 1919 group of 193 cases.....	1

TABLE XI
Location of Stones

	Cases
Ureteropelvic juncture	38
Upper third of ureter	49
Middle third of ureter	7
Iliac crest	4
Lower third of ureter	198
Ureterovesical juncture	53
Intramural	32

TABLE XII
Bilateral Involvement

	Cases
Bilateral ureteral	5
Stone in same kidney	29
Stone in opposite kidney	9
Stone in bladder	1

Mortality

Case 216040: Operation, ureterolithotomy; patient died thirteen days after operation; marked urinary extravasation was found.

Case 72640: Operation, combined ureterolithotomy and appendectomy; patient died of general peritonitis.

TABLE XIII
Duration of Symptoms before Nephrectomy for Ureteral Stone

	Cases
1 to 5 years	22
5 to 10 years	11
10 to 15 years	8
15 to 20 years	6
20 to 25 years	2
25 to 30 years	2
Average	8.5 years

(16 of these patients had stone in the kidney also)

TABLE XIV
Information Received in Answer to "Follow-up" Letters

Operations since leaving the clinic.....	12
For ureteral stone, opposite side.....	2
For ureteral stone, same side	0
For renal stone, opposite side	1
For renal stone, same side	1

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Nephrectomy, same side	4
(1 case complicated with nephrolithiasis)	
Nephrectomy, opposite side	1
Negative renal exploration, same side	3
Stones passed since operation	31
Stones passed previous to operation	48 (12.3 per cent.)
Multiple stones (averaging 6) passed previous to operation	9

Letters received on an average of four and one-half years after operation stated that ureteral stone had occurred on the same side in 3 cases. In 2 the first operation had been performed in the Mayo Clinic, and in one it had been performed elsewhere.

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TUBERCULOSIS OF THE APPENDIX*

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EVER since the discovery of the tubercle bacillus by Koch in 1882 and the use of improved methods of tissue sectioning and staining have made a comprehensive study of tuberculosis possible, lesions have been found in practically every tissue of the body. Yet, although tuberculosis of the appendix was described by Corbin as early as 1873, one finds very little written or said on the subject since that time. Text-books ignore it altogether or accord it only passing mention and, although in the literature we find voluminous discussions of the general subject of tuberculosis as well as of appendicitis, very few articles deal with tuberculous infections of the appendix.

In all fairness, however, it must be admitted that it is a comparatively rare condition. Scott, in 1917, was unable to find in the Index Catalogue of the Surgeon-General's library and the Index Medicus more than 44 articles on this subject, and of this number only nine were written by observers in this country.

According to Scott's collected figures, the Montreal General Hospital found tuberculosis in 1.6 per cent. of 1259 appendices examined; Lockwood, of England, found 2 per cent. involved; Allen 2 in 80 cases, or 2.5 per cent.; Litz 8 in 257, or 3 per cent.; Robson 5 in 300, or 1.7 per cent.; Letule 2 in 300, or .7 per cent.; the surgical laboratory in the University of Pennsylvania 6 in 310, or 2 per cent.; Deaver 16 in 7610, or .2 per cent.; Scott 1 in 179, or .57 per cent.; Mayo, in 1905, reported 29 in 1888 cases, an incidence of 1.5 per cent., and in 1914, 71 in 12,003, or .5 per cent. At the University of Minnesota Hospital since January, 1916, 210 appendices have been removed and examined microscopically, and only 2, or approximately 1 per cent., were found tuberculous. From a statistical study Murphy concluded that 2 per cent. of all appendectomies showed tuberculous lesions.

From these figures one is impressed by the paucity of observations on this subject when one considers that in practically every hospital and clinic of the country appendectomy is one of the most frequently performed operations. This lack of recorded observations and statistics is in many instances due to neglect of the routine sectioning and examination of all tissues by a competent pathologist. Only too often the diagnosis and prognosis is made solely from the clinical history and macroscopic appearance of the organ upon removal. Doubtless many tuberculous appendices removed in a comparatively early stage are diag-

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nosed grossly as "chronic appendicitis" and discarded, and the patient is discharged without the benefit of early instruction concerning the disease which may continue to develop until at a later date the remaining tuberculous lesions become too far advanced for either arrest or cure.

Weaver also suggests that tuberculosis of the appendix in an acute condition may so closely resemble ordinary types of appendicitis and the more chronic forms, particularly the hyperplastic type, may so closely resemble malignant tumors that microscopic section is absolutely necessary for a correct diagnosis.

Müller's table of age incidence of the tuberculous appendix shows the majority of the cases to have occurred in youth, their incidence roughly corresponding to the curve of occurrence of pulmonary tuberculosis. The ages affected showed wide extremes, the youngest a child two years of age and the oldest a man of forty-seven, but the largest number occurred in young adults. The disease is also more common in males than in females, the ratio being 3:2.

TABLE I

AGE INCIDENCE OF TUBERCULOUS APPENDICITIS (MÜLLER)

Years	Cases
2-9	3
10-19	18
20-29	21
30-39	16
40-49	6

Tuberculosis of the appendix may be either apparently primary or secondary to tuberculous infection in another part of the body. The former is naturally much more rare, in fact, so much so that its existence is denied by many authors. However, cases have been reported, *e.g.*, by Beck, where an autopsy failed to demonstrate any other focus. But one must bear in mind in such instances that there is always a possibility of a distant healed or latent focus or some microscopic lesion in a lymph-node which may have served at some time as the primary seat of the infection. In such cases as well as those of true primary infection, the theoretical possibility of which must be admitted, removal of the organ would probably result in complete cure. On the other hand, it is sometimes true that the accidental finding of tuberculosis in the appendix has been the first intimation of the presence in the body of this disease which later developed in other organs with serious consequences. Thus Mosher describes one such case of a tuberculous appendix, the condition being demonstrated by routine microscopic examination of the appendix from a case which gave no other signs of the disease at that time, but which died three years later of a pulmonary involvement.

The secondary form is frequently associated with tuberculosis of the intestines, particularly of the caecum, or, more rarely, of the adjacent

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affected fallopian tubes, a fact occasionally demonstrated by autopsies upon tuberculous patients. The question is raised by Kelly and Hurdon whether tuberculosis of the appendix antedates or follows infection of the cæcum. They point out that very frequently the more advanced lesions are found in the appendix. Whether local infection occurs by ingestion or by the haematogenous route, it would be natural to suppose that the bacilli might be equally disseminated along the alimentary tract with several foci appearing simultaneously, yet developing with different degrees of rapidity. Many authors, including Mayo and Brewer, report that in their experience tuberculosis of the appendix is practically always associated with the same infection in the cæcum, while, on the other hand, most observers are familiar with the fact that ileocecal or intestinal tuberculosis is very frequently found with no involvement of the appendix, suggesting that the latter is usually secondarily affected. On the other hand, Fenwick and Dodwell found that in 17 out of 2000 autopsies on tuberculous patients the appendix was the only part of the digestive tract involved. Also Leseuer, in 144 examples of this type of appendicitis in autopsies on tuberculous patients, found 12 with no other lesion of the intestinal tract. There seems to be no good reason, therefore, to postulate any fixed rule in regard to priority of tuberculous infection of the appendix, any more than one would attempt such rules in regard to other regions of the body. Doubtless many factors, some of which are as yet only dimly recognized, contribute to the final locus of virulent tubercle bacilli. The same reasons that promote the invasion and disease of the appendix by other pathogenic bacteria may well contribute to its occasional primary or secondary infection by the bacillus of tuberculosis.

We may reasonably conclude, then, that tuberculous infection of the appendix may be produced, not only from contiguity to a neighboring lesion, but also by either the obvious haematogenous route from a distant focus, such as a pulmonary or bronchial lymph-node, or by the infected contents of the intestinal tract. It is particularly easy to reason that the bacilli may be swallowed, pass along the intestinal tract without causing a lesion, and finally, as do many foreign bodies and parasites, lodge in the appendix and there cause an infection. The most obvious method for tubercle bacilli to enter the intestinal tract would be the swallowing of contaminated sputum, yet it might also be brought about by infected milk, butter, cheese, or other food, and in this way cause a primary tuberculosis of the appendix. This possibility of infection becomes much more worthy of consideration when one remembers the usual dependent position of the appendix and the fecal stasis frequently occurring there.

Aside from the intestinal route, primary infection has been supposed to occur in certain cases by blood or lymph streams after direct passage through some epithelial surface. Although this is a possible theory, one finds difficulty in considering it as a probable fact, especially after study of the usual route by which the large majority of tuberculous infections

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of the body probably occur. Such studies strongly suggest that almost all primary foci of tuberculosis in the body are situated either directly on exposed surfaces or in the neighboring lymph-nodes, the bacilli gaining entrance by inhalation or ingestion. Hence, ingestion of infected food would appear to be a more logical explanation of primary tuberculosis of the appendix.

Three forms of this disease are usually recognized: (1) Miliary, (2) hyperplastic, and (3) ulcerative. The so-called miliary type, however, although a true tuberculous appendicitis, is not deserving of special discussion, constituting, as it does, not a definite entity in itself, but usually being associated with a general miliary tuberculosis or tuberculous peritonitis. It really represents only a localized incident or part of a generalized infection.

The hyperplastic form is the rarest and is characterized by its very large size, a thickened wall and marked connective tissue proliferation, but little or no caseation. Occasionally the organ may be large enough to be palpated through the abdominal wall and is sometimes mistaken for a true tumor. The walls are markedly increased in thickness, measuring from .5 cm. to 3 cm., Tiedenat describing one measuring 5 cm. in diameter. The connective tissue overgrowth may not be entirely uniform, and by contraction may cause an irregular shape of the organ with stenosis, or, more rarely, obliteration of the lumen. This irregular shape, together with the large size, may further suggest a neoplasm. But the latter should be easily differentiated in that it is usually more circumscribed with a sharp line of demarcation from the normal tissue, while in the tuberculous process the affected tissue merges gradually into the normal with ill-defined margins. The mucosa is usually intact and normal in appearance. The submucosa may or may not present tubercles, but it is in the muscle coats that there are the most characteristic changes. Here, through and between the muscle bundles, is found an enormous increase in connective tissue, causing the large increase in the thickness of the walls. Throughout the entire tissue are scattered lymphocytes, plasma cells, and some eosinophiles. In some areas these cells congregate in varying sized masses and show in addition some endothelial cells and occasionally a giant cell, suggesting that these are the possibilities of new tubercles whose development is apparently inhibited or replaced by a marked proliferation of connective tissue. Caseation in this form is seldom seen, its absence as well as the large amount of connective tissue proliferation being due either to an attenuated strain of tubercle bacilli or (the other side of the shield) a high individual resistance.

It has also been suggested that this type of appendix, with its gross suggestion of neoplasm, may, under low power or hasty or incompetent examination, be confused with malignancy. The nests of cells may suggest embryonic tumor cells surrounded by connective tissue. This type may be either primary or secondary, but in either case is ideal for

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operation, as from its histological character it represents a slowly advancing, well controlled process, and removal should give a good prognosis.

The most common form is the ulcerative lesion. It may be primary, but is usually a direct extension from lesions in the intestine, particularly the cæcum, or, more rarely, may possibly represent a hæmatogenous infection from a distant focus. The diagnosis can be made only by the microscopic section. Grossly, the organ may appear normal except for congestion of the superficial capillaries. Occasionally the walls may be slightly thickened or may show fine adhesions or tubercles over the serous surface. The mucosa is usually entirely or partially absent, due to the more or less extensive ulceration. Very often caseous material may appear as foci or forming the greater part of the floor of the ulcers.

Microscopically, the serosa appears normal or shows a few tubercles. The muscle coat is usually affected but the mucosa and submucosa show the most extensive involvement, which may be in the form of discrete tubercles or extensive ulceration or necrosis. In very advanced cases the ulceration may extend through the entire wall and cause perforation, resulting in general septic peritonitis or periappendiceal abscess formation. In the earlier stages the ulceration first appears at either the tip or base, corresponding to the points where fecal stasis is often found. This is the form one finds most often in those terminal cases where the infection becomes overwhelming and the digestive tract becomes attacked by a rapidly developing tuberculous condition just preceding a fatal termination.

Scott maintains that the tuberculous type of appendicitis may be differentiated from the suppurative form by the greater chronicity, a frequent afternoon rise in temperature, loss of weight and prostration. Even the acute attacks, when they do occur, are milder and there is an absence of leucocytosis or sustained hyperpyrexia. Other authors feel, however, that a differential diagnosis between the suppurative and tuberculous forms is always difficult and often impossible. Eisendrath quotes the statistics of Brunner which include all the published cases in which appendectomy had been performed up to that time. In these and his own 7 cases, making 58 in all, he finds 16, or over one-fourth, had symptoms identical with those of acute appendicitis. Kelly and Hurdon share the same opinion regarding the possibility of diagnosis and also note that diarrhoea and blood in the stools were frequently not noticed in the clinical data. Also the symptoms are frequently obscured by those of the co-existing tuberculous process in the intestine or cæcum.

I have three cases to report, one of which is of especial interest from the pathologist's point of view, as no signs or symptoms of tuberculosis were found in any part of the body until the routine microscopic section of the appendix revealed the lesion.

CASE I.—Young man, twenty-six years of age, a Norwegian, admitted to the University Hospital on April 12, 1919, with a diagnosis of chronic appendicitis and the suggested possibility of its being of

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the tuberculous type. He complained of recurring, almost daily, attacks of pain in the region of McBurney's point associated with persistent but not severe diarrhoea. His family history was negative except for the fact that his mother developed a tuberculous ankle at the age of forty-eight. With the exception of scarlet fever at twelve he had always been well until the summer of 1917, when he began to have slight attacks of pain in the right side of the abdomen. These were frequently followed by a chill and diarrhoea. They would appear about every two weeks and the pain and discomfort often lasted a week. These attacks gradually grew more severe but shorter in duration until Christmas time in 1918, when they became very severe and were accompanied by hard chills. He consulted a physician who advised him to go to a hospital, but as he felt better for a time he waited until April, 1919. During the last two years he has had about two loose stools a day, but the condition was hardly severe enough to be termed a diarrhoea.

The physical examination showed a fairly well-nourished and well-developed young man. There was a large yellow spot on the anterior surface of the right tonsil. This was not removable, as a membrane would be, or depressed like an ulcer. The submaxillary lymph-nodes were enlarged. The chest was normal except for bronchovesicular breathing in the right apex and below the right clavicle. Cog-wheel breathing was found below the left clavicle, but no râles were heard. In the abdomen there was some tenderness in the lower part, slightly more to the right than to the left. Upon sitting up more definite tenderness was found in the right lower quadrant. The urine was negative. The haemoglobin was 100 per cent. and the leucocyte count was 10,200. Red count and differential were not done. The temperature was usually normal and never above 99°.

On April 29, 1919, the appendix was removed by Dr. Donald Cameron, who noted that the cæcum at the base of the appendix appeared red and thickened. The appendix itself was also congested to a moderate degree. The patient made an uneventful recovery and was discharged from the hospital on May 5, 1919. Following his operation, however, his temperature occasionally reached 99.2°, but during the last week in the hospital it fluctuated daily from sub-normal in the morning to 99.2° to 99.4° in the afternoon.

In the routine examination of the appendix it was opened and the mucous membrane presented the frequently described "moth-eaten" appearance with ulceration of practically the entire mucosa. There was, however, no caseous material to be seen, nor did the ulceration extend beyond the submucosa. The microscopic section shows the serosa and muscle coats normal except for a very mild infiltration of lymphocytes and eosinophiles. The submucosa contains many typical tubercles, consisting of endothelioid cells, lymphocytes, and very typical giant cells. All of these tubercles are microscopic in size, some being sharply circumscribed and standing out in marked contrast to the surrounding tissue, while others appear more ill

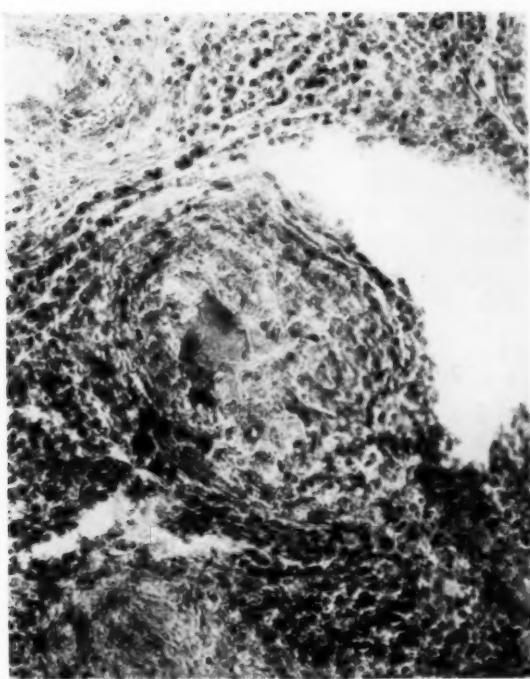
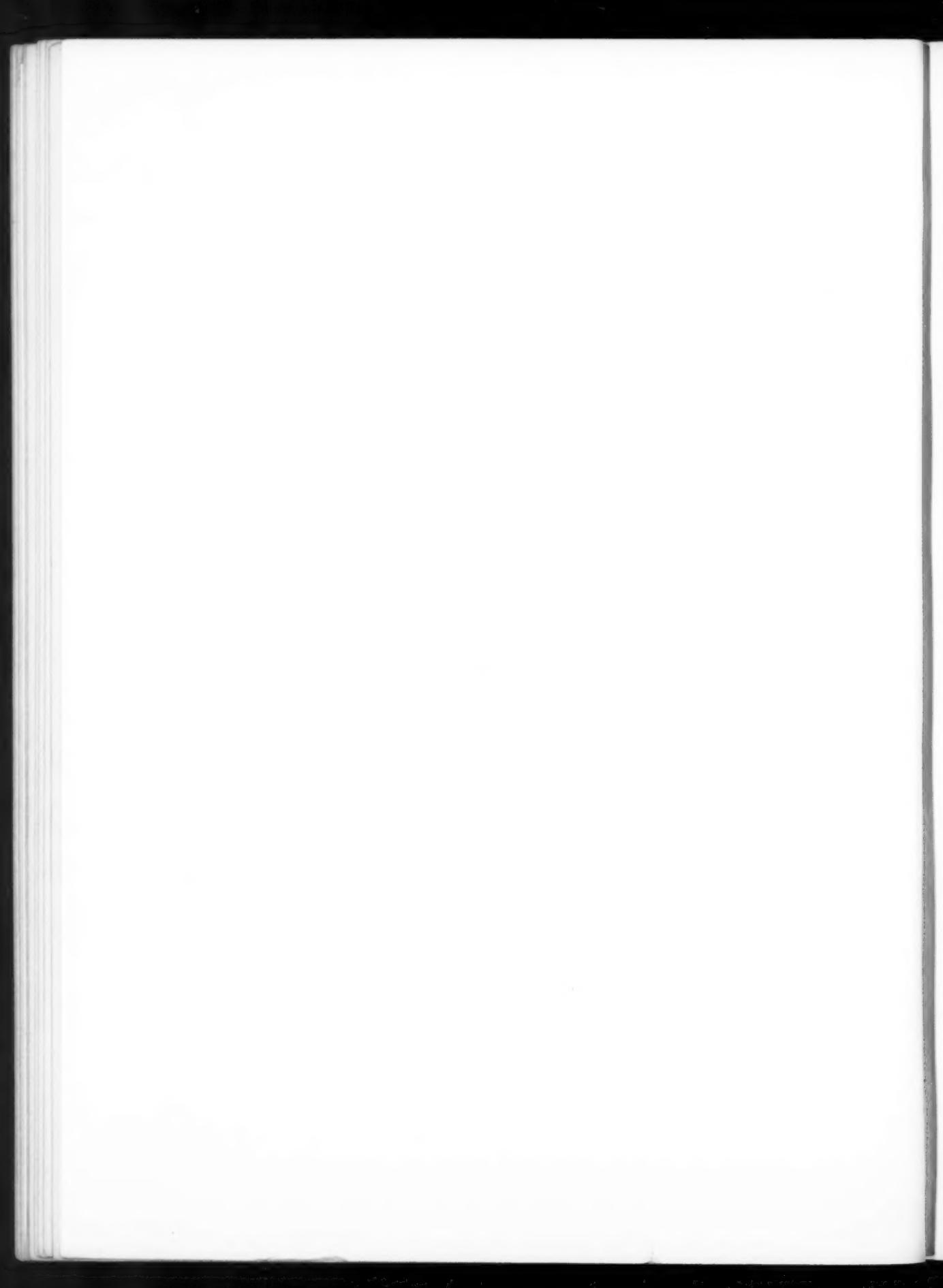


FIG. 1.—(Case I.) Showing a tuberculous area in the submucosa and absence of epithelium.



FIG. 2.—(Case III.) Showing the intact mucous membrane, the marked thickening of the walls by connective tissue and the infiltration with lymphocytes. Other areas showed epithelioid cells and a few giant cells.



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defined, merging into the tissue of the submucosa, which also contains many eosinophiles. The mucosa has entirely disappeared as a result of the ulceration (Fig. 1).

On November 15 the patient was again admitted to the University Hospital, complaining of general oedema, ascites, hydrothorax, and a decompensating heart. His incision had remained healed but his abdominal pain and discomfort had been only partially relieved by the operation. In the hospital he grew rapidly worse and died on December 2, 1919. The necropsy showed hydrothorax, ascites, general oedema, thrombosis of the right external jugular and subclavian veins, chronic adhesive pericarditis with marked dilatation of the heart (right ventricle), and tuberculosis of the intestine and the apices of both lungs. The tuberculous condition in the apices represented an acute exacerbation superimposed upon an old chronic process. There were marked adhesions to the chest wall, a fibrosis of both apices, and for a distance of about 5 cm. below were numerous miliary tubercles. In addition the right lung presented a caseous area about $\frac{1}{4}$ cm. in diameter and surrounded by a firm wall of connective tissue. The left lung showed, besides a few small caseous foci and miliary tubercles, a cavity 1 cm. in diameter with a ragged necrotic lining.

In the small intestine were a few discrete ulcers averaging 1 cm. in diameter, with puckered, thickened overhanging margins. Some of these showed evidences of partial healing, while a few were entirely healed. The cæcum was markedly thickened and the mucous membrane was replaced by extensive diffuse ulcerations. The colon also showed numerous large ulcers practically surrounding the lumen of the bowel and very similar in appearance to the small ulcers of the ileum.

This case is particularly instructive as to the potential value which might follow careful routine examinations of the appendix. In the present instance the tuberculous appendix was the first definite evidence of the probable existence of other tuberculous lesions. If these patients are warned of their condition and referred to tuberculosis consultants, precautionary measures might be adopted early enough to bring about arrest of the remaining lesions. Abnormal prolongation of the convalescence period would be the simplest of such procedures. Perhaps the majority of such patients are doomed at the time of operation, but it would be much more gratifying if one could know that no effort to effect a cure had been neglected. The autopsy shows clearly that the primary lesion had resided for some time in the apices of the lungs. An acute exacerbation of these lesions followed ulceration of the intestines and invasion of the appendix.

CASE II (From the University Hospital).—A woman, twenty-nine years of age, from the Walker State Sanitorium for Tuberculosis, was admitted on September 29, 1917, with a diagnosis of chronic appendicitis. She gave a history of having had some sort of "lung trouble"

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ever since she was five years old, and of very definite active pulmonary tuberculosis with hemorrhage for the past three years. For one year before admittance she had attacks of pain which came on suddenly, were accompanied by fever, and were followed by a chill. These attacks appeared first as severe pain all over the abdomen and later localized over McBurney's point. They lasted sometimes only for a few minutes and at other times for a whole day, but in either case were followed by definite tenderness in the right lower abdomen.

Physical examination showed, besides active pulmonary tuberculosis, rigidity of right rectus and tenderness over McBurney's point. The urine was negative; the sputum contained large numbers of tubercle bacilli; the leucocyte count was 13,650, with a differential of polymorphonuclears, 80 per cent.; lymphocytes, 13 per cent.; large mononuclears, 2 per cent.; transitionals, 2 per cent.; and eosinophiles, 3 per cent. The temperature showed a daily afternoon elevation, ranging from 99.6° to 100.8°.

On October 11, 1917, under nitrous oxide anaesthesia, an appendectomy was performed by Dr. J. F. Corbett. Both the cæcum and appendix were found to be markedly thickened and surrounded by a closely adherent omentum. The incision healed, the convalescence was normal, and the patient was discharged November 11, 1917. On section the appendix showed throughout the thickened wall definite tuberculous nodules and deep ulceration of the mucosa. The microscopic examination revealed absence of mucous membrane and deep ulcers extending well down into the submucosa. The wall was markedly thickened by a large amount of connective tissue and throughout were numerous endothelioid cells and giant cells with beginning necrosis.

This particular appendix earlier in the disease undoubtedly represented an example of the hyperplastic form, but at the time of removal, due to the overwhelming general tuberculous infection, showed a terminal stage where the resistance of the body was not great enough to result longer in fibrosis and both the newly formed connective tissue and the mucosa and submucosa were affected by rapidly accelerating tuberculous destruction.

CASE III.—(Reported by courtesy of the patient's physician, Dr. Arnold Schwyzer, and of Doctor Kaplan, pathologist to St. Joseph's Hospital in St. Paul.) The patient was a Jewish man, thirty-seven years of age, giving a negative family and personal history. Two years ago he had an attack of pain in the right iliac region. This was not very severe and was not accompanied by vomiting, but marked constipation was present. Olive oil relieved the condition but the soreness in that region persisted for a long time. On November 4, 1919, he had a similar but less severe attack. He was admitted to St. Joseph's Hospital, a diagnosis of chronic appendicitis was made, and an appendectomy performed. The urine at that time was normal and the leucocyte count was 7200. The appendix was 8 cm.

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long and, even after formol fixation, $1\frac{1}{4}$ cm. in diameter. It was very hard and stiff with numerous small white tubercles scattered over the serosa. The cæcum appeared normal.

Microscopic section shows a much thickened wall. In many areas the serosa exhibits some small yet typical tubercles. The muscle coat is thickened and separated widely by a large amount of connective tissue with a few plasma cells, lymphocytes, a few endothelial cells, and occasionally a giant cell. These collections vary in size from only a few cells to areas more than covering a high power field. These foci evidently represent tubercles in various stages which are hindered in development and largely replaced by the enormous increase of connective tissue. More definite tubercles are found in the submucosa, but at no point is there necrosis. The mucosa appears normal and intact (Fig. 2).

This case is a very typical example of the hyperplastic type of this disease, while the first one illustrates just as well the ulcerative form. In both first and third cases diagnosis was made only by the routine section and examination of the appendix. In the absence of any other findings the third case may prove to be one of primary infection. However, in view of the later development of many such cases and of the frequent slow course of tuberculosis this patient should be kept under close observation for the next few years.

The terminal tuberculous appendicitis deserves at least a passing mention here, for, while not a separate process, it appears only under certain conditions. Pathologists connected with tuberculosis sanatoria consider this type of appendicitis very common. But here we find it only a part of an overwhelming terminal phase of a long existing infection in another part of the body. It is usually associated with tuberculosis of the intestine and cæcum and does not deserve special classification.

From this study one is justified in concluding (1) that tuberculous appendicitis is a definite entity which, though rare, should be considered in both diagnosis and prognosis and surely justifies routine sectioning and careful examination of all appendices removed at operation. Demonstration of the lesion may save many lives either by removal of the primary focus or by making a diagnosis so early that immediate treatment may bring about arrest or cure of the general condition.

2. The disease may be primary or secondary.
3. Infection occurs directly from the intestinal contents or by the haemogenous or lymphatic route.
4. It may produce either the ulcerative, hyperplastic, or miliary type.
5. It can frequently be diagnosed only by microscopic examination.
6. The symptoms resemble very closely those of suppurative appendicitis.

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“NO SURGICAL APPENDICITIS WITHOUT ORGANIC STRICTURE”*

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THE essential contention of the first part of this argument is “That attacks of acute suppurative appendicitis are caused by the complete closure of a preformed stricture.” The observations and reasoning, which form the basis of this argument, run back over a period of ten years, the greater part of which time and effort was devoted to a checking of my belief and to the insertion of minor qualifying clauses. Unfortunately due to the pressure of other work and interests, I have no written clinical records sufficiently comprehensive to cover all the points discussed, but inasmuch as in this research I attained correlation by the simple expedient of acting as surgeon, clinician and pathologist in one, further detail would not materially improve the scientific standing of my contention. In order to minimize the personal equation, and to prove or disprove my theory scientifically, it is obvious that the problem should be tackled by surgeons, pathologists and clinicians independently, and their final conclusions compared. Suffice it to add that during these years as assistant to Dr. P. Y. Tupper, as incidental assistant to other surgeons and in my own personal cases, I have enjoyed liberal opportunity of studying the problem. In over 250 acute appendicitis cases and in well over twice as many interval cases, I have been able, satisfactorily to myself, to check the clinical history against the pathological finding, and *vice versa*, and in a large percentage of these cases to learn of or follow the course in later years.

With these preliminaries out of the way, let us proceed to our observations on and considerations of the living gross pathology. Any surgeon accustomed to seeing acute suppurative appendices within the first twenty-four hours from the beginning of the attack, must have noted that whereas the whole distal end was greatly distended and engorged, the cecal half-inch more or less very commonly appeared practically normal. There is, to be sure, usually a slight oedema and injection of the relatively normal part of the appendix, and in a small percentage of cases the inflammation of the appendix runs flush up to and even out onto the cecal wall. In appendices removed at this stage, with a normal appearing section distal to the clamp, it has been my experience in the great majority of cases that, although there is obviously fluid under tension in the appendix, none escapes from the severed end, nor can it be made to do so even by increasing, *via* manipulation, the intra-appendiceal pressure markedly. Now if an eight-inch olive-pointed sound, or an ordinary match-head, which fulfils every requirement, be passed through the

* Read in modified form before the St. Louis Medical Society, June 3, 1919.

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normal part of the appendix, it will meet firm resistance at the line of demarcation noted on external examination. This of course diagnoses the stricture, while the fact that the stricture was pervious until just before the attack can be verified grossly by the finding of decomposed fecal material in the shut-off portion of the appendix. The firmness of the white fibrous tissue in the stricture determines that it existed before the onset of the acute attack, while on complete sectioning the marked differences in the gross appearance of the mucosa proximal and distal to the stricture demonstrate beyond reasonable doubt, in my opinion, that the stricture is the controlling factor. In a few cases the stricture allowed pus to leak out from the appendix at this early stage, which would obviously be a fortunate turn of the fates for any patient not in a place or condition for a surgical operation. But while noting the rarity of leakage from the appendix into the cæcum during early stages, let me state my judgment that it is a common occurrence in later stages, which leakage by acting as an alternate way out for the pus avoids many a perforation.

And now passing on to the consideration of appendices seen in later stages, let me recall to mind some of the gross physical characteristics of the still all too common gangrene. A typical early stage of gangrene might be pictured as a distended appendix, perchance pretty evenly of a dark purple or, if fecal concretions happen to be present, more advanced grayish spots in association with these concretions. But the point I wish to call attention to is that in the great majority of cases this beginning gangrene stops abruptly at variable distances out from the cæcum. In cases seen still later, when the gangrenous process has reduced the appendix to a skeleton of blackened submucosa, an intensely red stub may be noted in most cases protruding from the cæcum. To be sure, as in other stages, the gangrene in a small percentage of cases involves all the appendix flush up to the cæcum. Finally for a variable distance away from the appendix the mesentery is involved in the gangrenous process, ordinarily in direct proportion to the appendiceal condition.

Now as to the cause of this gangrene, there has been a widespread tendency to attribute it primarily to interference with and eventually complete blockade of the blood supply of the appendix. Admittedly in all gangrenes there is an interference with and eventually complete blockade of the blood supply, and yet in all such cases we must go one step further and answer the question as to whether the blockade of the blood supply was primary, the infection being a secondary sequel, or whether the infection was the primary element, the clotting of the blood in the vessels being secondary. To cite typical examples of these alternates,—in senile gangrene with arteriosclerosis plus thrombosis the interference with the arterial supply is obviously the essential element, whatever infection occurs being distinctly secondary, whereas in diabetic gangrene with normal vessels the infection makes fearful progress on account of lowered resistance, the clotting of blood in such cases being distinctly a secondary process. Or to illustrate my point by the war experiences, while in many cases the interference with the arterial supply was

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the sole factor in the production of gangrene and in others obviously the controlling factor, still in many cases infection played an equal or larger rôle, and in a big proportion the relative virulence of the infection was practically the only factor in the development of gangrene.

And now as a means of getting directly to the heart of the problem, let me state my conclusion at the outset, which is that in a case of gangrenous appendicitis the infection is the primary and controlling element, whatever clotting of blood there is being secondary. To marshal the reasons on which I base this conclusion, in the first place the probability of an embolus lodging exclusively in the appendiceal artery is so infinitesimally small that even the supporters of the haematogenous origin of appendicitis admit it is practically not worth considering. On the basis of the common concurrence of infection elsewhere in the body and appendicitis they argue a selective affinity of certain blood-transported bacteria for the appendix, and further have presented some animal experimental evidence claimed to sustain their view.¹ The routine answer to that contention is that such cases of infection elsewhere and appendicitis are coincidences, with no or at least a very indirect cause and effect relationship. While the supporters of the haematogenous origin of appendicitis unquestionably feel that they have gathered sufficient evidence to be entitled to a respectful hearing, it would be relying on ignorance of recorded observations to make claims beyond that point. But to bring forward my specific points against the haematogenous theory, if my preceding observations are correct, it is obvious that the proponents should amend their claim to read "a selective affinity for the distal portions of the appendix." Further let me state definitely that I have found the same relationship between stricture and appendicitis, absolutely irrespective as to whether the patient was suffering from an acute or chronic infection elsewhere, or not. And granting the presence of a firm stricture, which locks up bacteria-laden faeces, surely no one would claim that any other factor was necessary to account for all the phenomena of acute suppurating appendices.

As regards judging from the gross appearance of a series of acute appendices as to whether the infection is primarily in the blood supply, I tried to weigh this problem as impartially as possible, but naturally would have some residual prejudice. Consequently I lay no stress on my judgment that the evidence seemed to me to point strongly to the origin of the infection within the lumen. But to show that my contention that the infection in appendicitis progresses from the lumen outwardly is in agreement with the general opinion of pathologists, let me offer this quotation from MacCallum in Text-book of Pathology, 1916, page 226: "Appendicitis is an acute infectious disease produced by the invasion of bacteria from the lumen into the mucosa and other walls. The haematogenous infection of the appendix walls by bacteria transported from infected tonsils, which Kretz regards as

¹ E. C. Rosenow: Etiology and Experimental Production of Appendicitis, Ulcer of the Stomach, and Cholecystitis. *Tenn. State Med. Assn.*, vol. viii, No. 5, pp. 205-209; also *Journal Infectious Diseases*, vol. xviii, No. 4.

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a common origin of appendicitis, has not been clearly shown to take place. If it does so it must be considered an exceptional occurrence, and does not explain the majority of cases in which infection from the lumen can be conclusively demonstrated."

The pathology of the true chronic appendix is, in my judgment, absolutely the same as outlined above for the acute appendix, except for the absence of acute infection. The stricture, which is pervious during interval stages, may be located at any point from near the distal end down to the very connection with the cæcum. If the stricture is located at the cæcum or relatively close up, it would obviously not be demonstrable after a routine appendectomy, which would account for a certain number of true chronic appendices apparently without stricture. But in these cases the stricture can be readily made out by palpation and can even be demonstrated to those about the operating table, provided they know the appearance of the normal for a contrast. If there have been only a few and minor previous attacks the submucosa may not have changed materially from the normal, but when the process has gone on longer the whole submucosa distal to the stricture becomes much thickened. In regard to the relation of appendicitis and adhesions, the evidence seems to be overwhelmingly in favor of the appendicitis as the cause of the adhesions, rather than the reverse, as is so commonly argued. Genuine kinks of the appendix are, in my experience, usually associated with stricture at the site, while all pathology of spurious kinks vanishes when the organ is removed from the body. I have seen two cases in which the stricture at the time of removal was only relative, that is the fecal concretion was of such a size that it couldn't possibly pass through the intervening normally patent submucosa into the cæcum. Finally in patients from whom the appendix was removed purely incidentally to some other abdominal operation, I have found quite frequently strictures within the last quarter or half inch of the tip. Fact is this finding has been present with sufficient frequency to make me sympathize with those who look on this common obliterating process not as a true involution but as the end-result of an inflammation. And further that the occasionally found mucoceles, distal to a stricture, are simply a transitory stage in the progress towards complete obliteration.

And now to discuss briefly some related points purposely postponed until this stage of the argument. Acute catarrhal appendicitis without stricture, such as is to be found, for example, in typhoid fever² and presumably any other acute enteritis, does not give the symptoms of surgical appendicitis nor call for operative intervention. The same logic seems to me fully as justified in regard to the question of chronic catarrhal appendicitis without stricture, that is rational control of the whole process and not simply appendectomy. While tuberculosis and similar infections may theoretically attack the appendix exclusively, practically they usually attack the large intestine concurrently and besides they do not give *per se* the symptoms of surgical appendi-

² McCrae: Osler's Modern Medicine, 1907, vol. ii, p. 98, par. 3.

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citis. As to the cause of the formation of strictures in the appendix, beyond the unsupported surmise that a simple ulcer precedes the development of the stricture, I have absolutely nothing to offer. Inasmuch as during the finding of hundreds of strictures of the appendix I have never seen this theoretical pre-stricture ulcer, I feel justified in drawing the conclusion that the ulcer only rarely, if ever, gives symptoms leading to surgical intervention.

During these years of testing my conception of the pathology against the clinical course of the disease I have made it an invariable rule to separate those cases which definitely had a stricture from those cases which definitely did not have one, leaving out of consideration a few cases of doubtful classification. The differences between these two groups were so marked as regards both the past and the future that any one who draws this pathological line through a series of cases must be at once impressed by them. Thus, whereas the strictured cases, after throwing out of account as genuine first attacks such as gave absolutely no previous story of abdominal pain, almost all gave a definite history of characteristic sharp attacks, the non-strictured cases ordinarily told a much less characteristic story and very commonly failed to give any history at all of sharp pain. As regards future course the difference was even more marked, for practically all the failures to relieve belonged to the non-stricture group, which statement, however, does not deny at all that many of the non-strictured cases either were relieved or felt they were relieved, which from a purely practical point of view approaches the same thing. And finally the whole clinical course of acute suppurative appendicitis is so readily explicable on the basis of my conception of the pathology, to wit—The closure of the stricture ushers in the attack—the ensuing colicky pain due to the commonly futile attempts on the part of the appendix to empty out its contents—then the involvement of the appendiceal walls causing low fever with leucocytosis, the cessation of appendiceal peristalsis, and in its place localized tenderness to deep pressure.

The foregoing completes the brief of my direct evidence. And here many readers will undoubtedly have the mental reaction "While the preceding argument does not sound unreasonable, still what explanation have you to offer that such a proposition was overlooked in so intensely cultivated a field as appendicitis?" As far as my alleged facts are concerned they should be able to stand on their merits, but the question strikes me as pertinent and deserving an answer, particularly inasmuch as individual opinion and judgment has unavoidably entered to a minor degree into the argument. My explanation is that it's a borderland proposition—everybody's—and therefore proverbially nobody's business! The only way it could be worked out would be for surgeons, pathologists and internists really to put their heads together on the problem, or for an individual with a reasonable grasp of all three subjects to catch the significance of the various details and fit them into their proper place in the composite picture. Most all pathologists have stressed the important cause and effect relationship between strictures and surgical appendicitis, while in this argument I have simply gone one step

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further by adding the negative, without stricture no surgical appendicitis. As far as catching this negative point is concerned, the straight specialist in pathology would obviously be at a great disadvantage, inasmuch as he or she isn't really in close touch with the living pathology and complete clinical history, while the specimens delivered to him quite commonly do not include the stricture at all.

Finally, any one in touch with the literature and general sentiment in regard to appendicitis during the past ten years must have noted the gradual growth of skepticism among progressive men towards what I consider near-pathology and near-symptoms. In support of this statement I could quote internists of standing from the literature and personal communications more or less indefinitely, but as this argument is presented primarily to surgeons I will close my case with a recent protest from so representative a surgeon as Bevan (*Surgical Clinics of Chicago*, April, 1919, p. 309, par. 2). "There is one phase of the question that I should like to discuss with you, and that is the so-called cases of chronic appendicitis, those cases that have never had an acute attack, but which are supposed to have a chronic infection in the appendix giving rise to slight distress in that region. I want to state my opinion on this subject very strongly, and it is that most of these cases are mistakes in diagnosis, and not cases of appendicitis at all, and personally I do not recognize such a condition as chronic appendicitis which has never given rise to any acute symptoms."

CONCLUSIONS

1. Attacks of acute suppurative appendicitis are brought on by the complete closure of a preformed stricture.
2. The inflammation, eventually gangrene, is due to the action of the bacteria normally present in the locked-up faeces.
3. The true chronic appendix also has a stricture, which, however, is patent during intervals between attacks.

THE ADVANTAGES OF THE MIKULICZ TWO-STAGE OPERATION OF PARTIAL COLECTOMY

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THE early intestinal resections were largely done by the help of temporary artificial anai. As surgery progressed the elements which control sepsis were better understood and the wonderful healing power of the intestine was better appreciated. Immediate suture was successfully practiced and the one-stage operation became the procedure of choice either with immediate closure of the wound or with provision for drainage. An immediate healing with prompt restoration of function is surely more desirable than a delayed union and the discomforts of even a temporary intestinal stoma.

There are, however, certain advantages inherent in the two-stage operation. In 1902 Mikulicz formulated these advantages, described the operation which ordinarily bears his name and recorded cases which showed remarkable reduction in mortality rate. He had then used the procedure for more than five years. He thoroughly mobilized the portion of intestine which was to be removed and delivered it through the abdominal wound after stitching together the serous surfaces of its afferent and efferent portions. He then closed the incision to the emergence of the intestine, stitched the skin edges to the intestinal wall and applied protective ointment and a surgical dressing over the incision. This was all accomplished without opening the intestine. He either left the extruded portion in the dressing to be removed at a later time or excised it at once and provided for drainage at a safe distance from the wound. A temporary stoma was left. The "spur" was clamped through at a later time and then the intestinal ends brought together by suture.

Many surgeons have adopted this operation on account of its diminished mortality rate. However, the records published in surgical literature indicate that it is only used in a moderate portion of those cases for whom it might be considered suitable. For instance, in the last ten volumes of the *ANNALS OF SURGERY* we find records of 26 operations for obstructive disease of the colon. They were distributed as follows:

End-to-end suture	9
Lateral anastomosis	7
Short circuiting	6
Mikulicz operation	2
Exploratory operation	1
Colostomy	1

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If we study the 32 cases of cancer of the splenic flexure which Hartwell collected from the literature from 1906 to 1918, we find the following records:

Mikulicz, or similar procedure	9
Lateral anastomosis	7
End-to-end suture	5
Short circuiting	3
Colostomy	6
Colostomy with extirpation of tumor	1
End-to-side anastomosis	1
Inoperable cases	6

These reports show great diversity of method and suggest the desirability of further consideration of certain elements which bear on the relative advantages of one-stage operations and two-stage operations when portions of the intestine are to be removed. These elements are:

1. Septic intestinal content.
2. Extent of peritoneal intestinal covering.
3. Condition of patient.
4. Peritoneal sepsis.
5. Conservation of nutrition.
6. Skin irritation from leakage of intestinal content.
7. Reflex effect of fastening different parts of the intestine to the abdominal wall.

These elements differ in different parts of the intestine and in different patients.

Small Intestine.—The small intestine presents elements which favor one-stage operation in almost all instances. The intestinal content is fluid and, ordinarily, is rapidly moving and has little septic power. The peritoneal covering is close to the muscular wall of the intestine excepting at the small mesenteric border and hence gives abundant opportunity for strong opposition. Cancer is rare here and hence we do not often have to deal with debilitated patients. Furthermore, the disadvantages of the two-stage operation apply to the small intestine with especial force. Inanition results from too much intestinal leakage. Skin irritation, or even skin digestion, follow the leakage of fluid which still has digestive power. The reflex disturbance from fixation is greater from the small than from the large intestine. Hence the two-stage operation is only applicable to the small intestine in especial emergencies. For instance, strangulated hernia with gangrene of the intestine and spreading infection of the adjacent tissues.

Ileo-cæcal Region.—At the ileo-cæcal region the conditions still favor the one-stage operation. The intestinal content is still fluid, it has only moderate infective power and ordinarily moves with fair rapidity. The peritoneum of the ileum is close to the muscular coat excepting at the mesenteric border, and the peritoneum of the large intestine gives abundant opportunity for serous apposition of either lateral or end-to-side anastomosis. Provision for possible leakage is easily obtained.

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Colon; Hepatic Flexure to Terminal Sigmoid.—The colon from the hepatic flexure to the terminal sigmoid is the region for which the two-stage operation is especially considered. This region furnishes nearly 70 per cent. of the intestinal cancers above the rectum.¹ Here we have an intestinal content which is semi-solid, or possibly solid. It holds vast numbers of bacteria. Mayo states that it has been shown that one-quarter to one-third of the stool bulk is due to bacterial growth. Partial obstruction exists in a large proportion of the cancers of this region which come to operation, hence this septic intestinal content cannot be satisfactorily eliminated and forms a serious menace to satisfactory healing.

The peritoneal covering is frequently defective. This defect in the upper part of the descending colon is due to the anatomical arrangement which usually leaves the posterior portion of the gut uncovered by peritoneum. However, the deposit of fat between the peritoneum and the muscular coats of the intestine is sometimes the main barrier to satisfactory serous apposition. In the sigmoid and descending colon one frequently notices at operation that the strip of peritoneum which lies close to the muscular wall is only one-half to three-quarters of an inch in width and that there is a thick deposit of fat elsewhere. This fat deposit is shown in the appendices epiploici, but in many instances is massive and really envelops a large part of the intestinal wall. Of course, in those patients who are debilitated by cancer it has usually been absorbed, but some patients come to operation in whom it is still present, hence operation must be planned with the understanding that fat deposit may hamper serous apposition of the divided intestinal ends.

The condition of the patient may be a strong barrier to a successful one-stage operation. The majority of these patients suffer from cancer and have suffered for a long time before they come to operation. They have little resisting power and hence operative procedure must be planned so that they will not have more than they can endure.

Peritoneal sepsis does not often come in these patients, but a perforation is occasionally found which leads to considerable peritoneal sepsis and hence forbids a type of anastomosis which otherwise might be made.

The interference with nutrition, the skin irritation and the reflex effect of fastening the intestine to the abdominal wall are all minimized in the two-stage operation on the colon as compared with the small intestine.

We therefore have many reasons why a two-stage operation should be used in a large number of partial colectomies.

Statistics Comparing Results of Different Types of Operation.—If we study records of operations we find further reason for using the two-stage procedure. Mikulicz² emphasized the advantages of this procedure and gave detailed reports of its efficiency in the Breslau clinic. The mortality of intestinal resections by the one-stage operation was 42.9 per cent., whereas by his two-stage operation he did sixteen cases

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with only two deaths—a mortality of 12½ per cent.—and these two deaths were not, primarily, due to the operation.

The procedure has been much used in the intervening years. Oppel³ quotes Finkelstein as showing in the collective study of results that the mortality of the one-stage operation had been 29 per cent., and that of the Mikulicz two-stage operation had been 16 per cent.

Mayo⁴ states that the adoption of the Mikulicz-Brun's method has probably done more to extend operability and reduce mortality in resections in the second half of the colon than any other factor. By adopting this method in a large proportion of the operations he resected the left half of the colon, including the splenic flexure but not including the rectum, 184 times, with a mortality rate of 17 per cent.

Hartwell's⁵ recent study of cancer of the splenic flexure is very important, although discouraging. After a careful study of the literature, he estimates that the probable operative mortality of all cases, up to the present time, is over 60 per cent. But the results from operation in many stages is much better than that in one stage. He states that his "collected cases show a mortality approximately three times greater in the one-stage than in the many-stage procedure. Careful study indicates that the failures in the one-stage operation would have been avoided by the other mode of attack. These failures arose almost entirely from leakage somewhere along a suture line, with a resultant peritonitis or improperly drained abscess."

The late James P. Tuttle once told me that he had successfully done five successive partial colectomies by the Mikulicz method, whereas his previous mortality rate, in similar conditions by other methods, had been 33 per cent.

We thus see that there are abundant records to show that the two-stage or many-stage operation has a much lower mortality rate than the one-stage operation.

Record of Personal Operations.—The author's early cases were mostly admitted to the hospital on account of symptoms of obstruction. It was not always possible to secure satisfactory cleansing of the intestine. Anastomosis with immediate return of the intestine to the abdomen was sometimes successful and satisfactory, but, even in those patients in whom a preliminary colostomy was done, there were enough failures to lead to a search for a better method. The following cases illustrate the use of the Mikulicz method. The mortality rate, one in eight, is much better than that obtained by immediate suture.

CASE I.—*Adenocarcinoma of sigmoid.* A. L., aged fifty-one years. Roosevelt Hospital, No. A15023. Operation March 29, 1919. Fourteen months previously he had had an abscess beside the descending colon which had healed but had again been opened in February, 1919. At operation, an adenocarcinoma was found in the upper part of the sigmoid. This was mobilized and the diseased

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part of the intestine was delivered through the abdominal incision. The procedure was much hampered by the presence of the discharging sinus. A loop of small intestine was adherent to the sigmoid and was necessarily exposed to the infection from this sinus. It was, however, returned to the abdominal cavity. The diseased portion of the colon was delivered through the abdominal wound. Wound closed to the point of emergence after the afferent and efferent legs of intestine had been united. The wound was protected by ointment and gauze, protruding portions of intestine double ligated at a distance from the skin edges, tumor excised outside of primary dressing. Exposed mucous membrane cauterized. Ligatures cut forty-eight hours later. The patient died of general peritonitis six days later. His death was apparently due to infection from the sinus and attached coil of small intestine which had come in contact with it.

CASE II.—*Adenocarcinoma of descending colon.* Mrs. F. I., aged sixty-five years. One-year intermittent pain in left side. Worse of late. Had lost 25 pounds in weight. Palpable mass in left side of abdomen. Operation June 29, 1918. Intermuscular incision above and in front of anterior superior spine of ilium. Descending colon mobilized and delivered through the wound. Annular growth just above the sigmoid. Serous surfaces of afferent and efferent portions united with catgut. Wound closed to the emergence of intestine. Intestine stitched to skin; also further secured by tape. Ointment and surgical dressing applied over the wound. Protruding intestine double ligated. Diseased portion ablated external to the ligatures. Mucous membrane cauterized and secondary dressing applied. Ligatures removed on second day. Spur clamped in two weeks.

Second operation July 30, 1918. The operation was done in an adjoining city and patient had not been seen by the author since the primary operation. A clamp was applied to that portion of the spur which still remained. The intestinal edges stitched together to the emergence of this clamp and the union was reinforced by stitches through the fascia and skin. The wound closed promptly excepting for a very small sinus. The sinus soon closed completely. She made an excellent recovery and is now in good health with no evidence of recurrence.

CASE III.—*Adenocarcinoma of transverse colon.* J. D., aged fifty-three years. Roosevelt Hospital, No. A14317. Eleven months' history of cramp-like pains intermitting and recurring. Loss of weight, 15 pounds. April 15, 1918, partial colectomy through an incision in upper right rectus. Gastro-colic omentum separated from greater curvature of stomach. Growth mobilized and delivered; serous surfaces of afferent and efferent legs united with catgut. Wound closed to emergence of intestine. Skin stitched to intestinal wall. Dressing applied to abdominal wound. Clamps applied to intestine leaving about one and one-half inches between the clamps and abdominal wound. Clamps removed in thirty-six hours.

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There was satisfactory healing, but the patient was much debilitated and did not gain strength rapidly. Clamp applied to spur May 3. Attempt to close stoma by loosening the attachments and applying stitches in layers May 18. This was only partially successful and was repeated June 24. After this there was slight leakage, but the wound was entirely closed on September 3, and the patient has remained in excellent health ever since. Has done routine duty as policeman, and is now in excellent health.

CASE IV.—*Adenocarcinoma of descending colon.* Mrs. T., aged fifty-two years. Roosevelt Hospital, No. A14356. Abdominal pain, colic, vomiting recurring in intermittent attacks six weeks or more. Operation May 11, 1918. Long incision through the left rectus muscle. An annular constricting adenocarcinoma was found in the descending colon just below the level of the costal border. This and the adjoining portion of the intestine were mobilized and delivered through a second, left intermuscular incision. Serous surfaces of afferent and efferent legs united with catgut. Wound closed to the emergence of intestine. Skin edges stitched to intestinal walls. Intestine further held by glass rod. Wound dressed with ointment and gauze. Intestine double ligated outside the layers of gauze. Tumor and adjoining intestine ablated. Mucous membrane cauterized. Further dressing applied. Two days later the constricting ligature was removed from the afferent intestine; satisfactory intestinal stoma established. Spur clamped in two weeks. Colostomy opening closed in layers July 22. Patient left hospital September 12. All steps in her procedure were slow on account of her weakened condition. Wound closed satisfactorily, and she remains in excellent health at the present time.

CASE V.—*Colloid carcinoma of descending colon.* Mrs. E. W., aged thirty-two years. Roosevelt Hospital, No. A8521. Four months' history of cramp-like pains in abdomen and back. Operation May 9, 1917. Growth and adjoining portion of descending colon mobilized and brought through left abdominal wound. Serous surfaces of afferent and efferent legs joined with catgut. Wound closed to emergence of intestine. Skin edge stitched to intestine. Intestine further stabilized by glass rod. Two ligatures applied outside the dressing. Intestine excised outside the ligatures. Mucous membrane cauterized. Ligatures removed two and three days after operation. Suitable stoma established. Spur clamped two weeks after operation. Ends of intestine united June 12. Patient left hospital, with wound healed, June 30.

CASE VI.—*Adenocarcinoma of sigmoid.* Mrs. A. G., aged thirty-nine years. Roosevelt Hospital, No. A6340. Operation June 19, 1915, for a recurring cancer of the sigmoid. Intestine mobilized. Afferent and efferent legs united with catgut. Mobilized portion delivered through the left intermuscular incision. Skin edges stitched to intestinal wall. Dressing applied. Intestine double ligated outside the primary dressing. Ligatures about afferent end of intes-

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tine removed in forty-eight hours. Stoma established. Spur clamped in about two weeks. Ends of intestine sewed together July 29. Patient left hospital, with stoma closed, August 15.

CASE VII.—*Extensive tuberculosis of caput coli and lower ileum.* B. S., aged thirty-five years, General Memorial Hospital, December 12, 1912. One-stage operation not done on account of infection which was present. Mikulicz procedure with immediate removal of diseased intestine. Stormy convalescence owing, in large measure, to illness not connected with the intestine. Spur cut down; stoma closed. Patient left hospital after two months and made excellent recovery after three additional months of treatment, and remains well at the present time.

CASE VIII.—*Diverticulitis. Perforation. Abscess formation.* C. A., aged sixty-four years, Roosevelt Hospital, No. B3281. Three months intermittent, left abdominal pain and constipation. Large palpable mass in left side of abdomen. Operation September 13, 1912. Large mass, composed of perforated descending colon and encapsulating omental and pericolonic fat, mobilized and delivered through left lateral incision. Serous surfaces of afferent and efferent intestine stitched together with catgut. Abdominal incision closed to the emergence of the intestine. Skin edges stitched to intestine and retaining tape placed between the intestinal loops. Dressing applied. Ligation of protruding intestinal loops outside of primary dressing. Ablation of inflammatory mass. Exposed mucous membrane cauterized. External dressing applied. Ligature removed after seventy-two hours and stoma established. Part of spur clamped on fifth day to seventh day. Remaining spur clamped at a later time. An effort was made to close the stoma October 13. This was successful excepting for a small fistula which was closed on November 3. Patient left hospital on December 14 with wound satisfactorily closed.

This series of cases is too small for extensive deductions, but it is sufficient to indicate that the Mikulicz procedure is far safer in the colon than the one-stage procedure. The low mortality rate—12½ per cent.—corresponds to that of other operators. The one fatal case was due to a rare complication; we do not often find an open sinus and a loop of small intestine adherent to the infected area.

Of course, delay in healing, unpleasant convalescence and probability of hernia constitute the main barriers to this procedure. In this series the delay has often been longer than was absolutely necessary. While a debilitated patient is gaining strength steadily, but slowly, one hesitates about even moderate surgery when a little longer waiting is sure to make the closing of the stoma easier. Absence from the city also occasioned delay in some instances. Mayo begins the clamping of the spur ten or twelve days after the primary operation and expects its division to be complete in six more days. "A few days later the resulting colostomy can be closed by a simple extra-peritoneal operation." In two of my cases the healing was complete in respectively six and one-

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half and nine and one-half weeks. In five cases small sinuses remained for three to five months before final healing occurred. These were not enough to occasion serious inconvenience and the patients preferred delay to further stitching. When we appreciate the greater safety, we may be sure that most patients would be willing to purchase this safety by a delay in convalescence and the associated discomforts.

Final Results.—Proper mobilization of the desired portion of the intestines is the first element in obtaining good final results. If the adjacent tissues or lymph-nodes are involved, they, too, are to be removed when possible. This is done without regard to the method of excision. Considering the increased percentage of recoveries, the final results of the two-stage operation are much better than those of the one-stage operation.

Applicability of the One-stage Procedure.—Without doubt, there are patients in whom the one-stage operation can be successfully done. Such patients should be fairly strong and their colons should be nearly empty and should be comparatively free from fat. Before deciding to use this method, one may well remember the brilliant results which Mayo and Mikulicz have obtained by the two-stage procedure, and Hartwell's studies which show that the one-stage procedure has had a mortality rate three times greater than the many-stage method.

It is not my purpose to advocate the two-stage procedure for all cases, but rather to call attention to its advantages and to urge its use in the average case as it now comes to us in the hospital, reserving immediate suture in the colon for those patients who are especially fitted for it.

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ANATOMICAL CONSIDERATIONS IN THE RECTAL PROLAPSE OF INFANTS

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IN a former paper contributed to this journal I have drawn attention to certain functional characteristics of the perirectal tissue. In this I confirmed statements already made by my former colleagues, to whose work references are there given.⁷ In the dissection of the pelvis of the full-term foetus and the infant, certain additional facts have come to light which possess their own significance in the consideration of cases of rectal prolapse.

The investigation of cases of so-called rectal prolapse resolves the condition into three types, which are described by clinicians as commencing in varying situations:

1. At the anal margin.
2. At a certain distance above the anal margin and protruding.
3. At a higher level (pelvic colon) and not protruding.⁹

The second and third of these types clearly belong to the class of intussusceptions, differing from the ordinary clinical condition known as intussusception only in that the entering portion of bowel commences its progress through the intussusciens low down in the distal colon; it may be in the rectum itself. The anatomical features of the distal colon show there to be two situations favorable for the development of an intussusception. These are the pelvirectal junction and the subdivision of the rectum at the great valve of Houston. For at each of these positions there is a more or less marked infolding of the bowel wall, and both correspond to the junction of a higher comparatively mobile portion of the bowel with a lower, more fixed portion.

The nature of the fixation differs in the two instances. At the junction of pelvic colon with rectum there is the sudden loss of the mesocolon. The change from the presence to the absence of the mesentery cannot, however, be a very potent factor in inducing intussusception. Indeed, from the looseness of the subperitoneal tissue in this area one might well doubt whether it would have any importance at all.

In the case of the lower situation, namely, the location of the great valve of Houston, the problem is a different one, and one for which a more plausible solution is indicated. The muscular diaphragm of the pelvis, constituted in large part by the two levatores ani, is generally held to be the main support of the rectum. As I showed in the previous article, this is only partially true. Lack of tone in the pelvic diaphragm

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will certainly allow the rectum to become prolapsed to a limited extent. But the muscles indicated are not the only or indeed the main support of the rectum. The organ is upheld by the attachment to it of the perineural and perivascular tissue known as the rectal stalks¹ or *les ailerons*.² These form the lateral portions of the fascia propria,³ part of which does not become thinner as it passes upward, as Waldeyer suggested,¹⁰ but is attached to the sacrum at the level of the third sacral vertebra or thereabouts.⁷ The rectal stalks comprise the tissue surrounding the middle haemorrhoidal vessels and visceral pelvic nerves, of which branches from the third and fourth sacral trunks pass to the rectum. They are attached to the lateral walls of the perineal chamber^{6, 11} or ampulla of the organ. Hence this portion of the rectum is more fixed than the pelvic chamber to which no portion of the stalks is attached.

It is not, however, intended in this paper that attention be directed to intussusceptive forms of rectal prolapse, but rather to that type which commences at the actual anal margin, and which is thus a true prolapse or procidentia of the rectum.

Inasmuch as the manner of support of the rectum is concerned in cases of rectal prolapse, and in view of the occurrence of this condition in infants and young children, it may be of service to put on record the results of investigation on the infant pelvis.

On consultation of the literature for the accepted or suggested etiology of prolapse, some of the causes given recommend themselves with greater force than others to one's judgment. Overloaded rectum and straining at stool naturally have their place in the etiology of the condition, in association with other causative factors, such as lack of muscular tone in the pelvic diaphragm and diminution of the fat in the ischiorectal fossæ occurring in rickets and wasting diseases. As is well known, the sacrum of the infant is straighter than that of the adult, and consequently the rectum is more vertically placed. It is conceivable that all these factors, acting in harmony, will tend to produce rectal prolapse in young children. On the other hand, prolapse of a very persistent and troublesome nature does occasionally occur in children who, apart from the condition indicated, show no departure from normal health. Of other suggested causes, the so-called laxity of the submucosa, which is said to permit movement of the mucous membrane on the muscularis, cannot account for more than a mere pouting of the mucous membrane, for the laxity cannot be more than the blood-vessels which pass through the submucosa will allow. Laxity of the connections of the rectum with the sacrum is also given as a cause of prolapse in infants. But as will shortly be shown, there is no greater laxity in these attachments than there is in the adult.

A sagittal section of the pelvis at birth shows that the position of the rectum relative to that of the bladder (and of the uterus in the female) differs from the adult relation in that the latter organs are placed at a higher level in association with the small capacity of the pelvis. In other

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words, the rectum at birth is already in a position of mechanical disadvantage, inasmuch as it occupies a lower site than the other organs which, in later life, also descend entirely into the true pelvis. Since the plicæ transversales, or valves of Houston, are present in embryonic life, the exact position of the rectum relative to the vertebral column may be ascertained. In the dissection of a series of pelvises of new-born infants I find that the third or great valve of Houston lies opposite the fifth piece of the sacrum on the average, the variation being from the level of the fourth sacral to that of the first coccygeal vertebra. Hence at birth the third plica transversalis has already reached its adult position. This is the most constant portion of the rectum, and was therefore chosen as the indication of the true level of the organ compared with the vertebral bodies. Since I drew attention to this point,⁸ it has been brought out again by F. P. Johnson in a paper which gives additional information on the development of the rectum² beyond that which lay within the scope of my observations.

This site is, as one would expect, retained during childhood.⁵ Hence one may say that while the rectum in the infant occupies the same position relative to the vertebrae as in the adult, yet it is in a position of greater mechanical disadvantage from the higher position occupied by the bladder and uterus, as well as from the straight character of the sacrum, which cannot relieve the organ from pressure of overlying viscera as can the more curved sacrum of the adult.

Next one may consider the question of laxity of the attachments of the rectum to the sacrum in the infant.

The fascia propria of Waldeyer, apart from any continuation upwards into the fascia of the pelvic mesocolon,¹⁰ has a definite attachment (rectosacral aponeurosis) to the hollow of the sacrum between the third sacral foramina,⁴ forming a capsule for the rectum.⁸ The lateral parts of the rectosacral aponeurosis comprising the fibromuscular tissue around the middle haemorrhoidal vessels and visceral pelvic nerves has, in view of its relation to the last named, some fixation to the sacrum in the region of the second, third and fourth foramina (rectal stalks). It is to be remembered that only the third and fourth sacral nerves actually send branches to the perineal chamber of the rectum, but there is no anatomical subdivision of the fascia surrounding the several nerves. These nerves, vessels, and surrounding fascia correspond to the substance of the mesenteries by which other parts of the alimentary canal are supported. In a number of cases I made dissections of the rectal stalks in new-born infants and found that the stalk, simply isolated and as yet undissected, measures about half the length of the contained vessels and nerves if they are freed from vascular and perineural fibromuscular tissue. I found that these proportions obtained also in the adult specimens used as controls. For example, in a new-born female child the sacrum of which measured 42 mm. in length, the isolated but undissected

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rectal stalk measured 12 mm., while the dissected stalk consisting of nerves only was 22 mm. long. The corresponding measurements in a male infant, the sacrum of which measured 40 mm., were the following: Undissected stalk, 12 mm.; nerves only 25 mm. This comparative length of nerves and vessels allows some possibility of movement of the rectum as a whole, but so long as they remain uninjured, the movement of the organ is necessarily limited. In no case did I find the dissected rectal stalks long enough to allow the great valve of Houston to descend so far as the anus. In the female infant above mentioned, the distance from the great valve to the mucocutaneous anal junction was 36 mm.; in the male, 37 mm. With a maximum length of rectal stalk of 22 and 25 mm., respectively, it is plainly seen that prolapse must be limited. The same approximate proportion is found in the adult.

In a male subject of thirty-five years of age, in which the dissected rectal stalks measured 60 mm., the sacrum was 115 mm. in length and the distance from the great valve of Houston to the mucocutaneous anal junction 75 mm. The length of the dissected rectal stalk is approximately one-half that of the sacrum. In a female twenty-five years old it was 55 mm. in length, the sacrum being 110 mm. long. The undissected rectal stalks in the adult male cited each measured 30 mm.; in the adult female, 20 mm.

As a result of the investigation, I find that in the adult the increase in possible length of the rectal stalk corresponds roughly with the amount to which the rectum can be drawn out of a perineal wound when the levatores ani, but not the stalks, have been completely severed. In the infant the length of the rectal stalks and their increase in length on dissection correspond proportionately to the condition found in the adult. There is, therefore, no greater laxity of the rectosacral attachments in the infant than in the adult. In both there is sufficient play in the rectal stalks to allow a certain limited prolapse in the presence of other accessory causative factors and without damage to the nerves and vessels themselves. In such instances, the prolapse must obviously be temporary, and it would appear unnecessary to resort to operative measures for its treatment.

SUMMARY

1. As estimated by the position of the great valve of Houston, the rectum at birth presents practically the same relation to the vertebral column as in the adult.
2. Similarly the rectal stalks are of the same proportionate length in the infant as in the adult. Hence in the former there is no greater laxity than in the latter.
3. The only anatomical characters which can be of special importance in infantile prolapse are the comparatively straight sacrum and consequently more vertical rectum.

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SARCOMA OF THE PROSTATE

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Age of Incidence.—Of the total of sixty-two cases recorded, 20, or nearly one-third, occurred before ten years of age; 45, or three-fourths, occurred before the cancer age of forty years; and 80 per cent. occurred before the usual age of prostatic adenoma (fifty years). These facts alone are of great diagnostic value. Therefore, a prostatic tumor occurring before fifty years of age is possibly sarcoma, and one occurring in adolescence is probably of such a nature.

The most common symptom was obstruction either of urination, or defecation, or both. This stage was, for the most part, rapidly reached, after the first signs of difficulty of urination, *i.e.*, in one to two months, and was thereafter a permanent symptom.

Pain in the younger patients was less marked, being absent in many, while in those past fifty years of age it was more marked. Perineal fullness and tension was a frequent complaint.

Rectal examination revealed a body compositely described as large, smooth, moderately firm, with uniform consistency, elastic, "balloon-like" (Powers¹), and only moderately, if at all, tender.

☛ Differentiation must be made from syphilis, tuberculosis and cancer.

With such a prostatic enlargement, a history of congenital or acquired syphilis, a positive Wassermann reaction, or other evidence of congenital or acquired lues, render the therapeutic test necessary. A tuberculous prostate does not become as large as a sarcomatous, has a varying consistency with small nodules or soft areas scattered over it. One or both seminal vesicles will be felt to be enlarged, nodular; nodules may be felt in the epididymis or vasa and there will be other evidence of tuberculosis. Cancer of the prostate usually occurs later in life than sarcoma, is smaller, has the well-known firm, nodular consistency, is irregular, more fixed and the interlobular sulcus is early obliterated. It spreads beneath Denonvilliers' fascia. In sarcoma the tumor is immediately and abruptly encountered by the examining finger.

Pathology.—Round and spindle cells have formed the majority of these tumors, though myxo-, angio-, lympho-, chondro-, myo- and fibro-sarcomas have occurred among them. Three cases of rhabdomyoma are improperly included.

Treatment.—Extirpation through either the suprapubic or perineal route followed by radium treatment is indicated.

Paschkis and Tittinger² drained the bladder, and inserted into the fistulous opening a tube containing 4.7 mm. of radium for twenty minutes.

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This treatment was repeated twenty-one times at two-week intervals. The swelling disappeared and all signs of the tumor were gone, but the authors do not regard the tumor as cured.

In excessively large tumors like that of MacGowan³ the perineal route seems preferable.

With the possible exception of the case reported by Paschkis and Tittinger, there has been no case of cure recorded, all dying of recurrence within four years.

Within the last two decades the prostate has no doubt been as thoroughly worked over pathologically as any tissue of the body. The fact that only 62 cases have been reported proves its rarity, and some of these are not genuine. We find it first mentioned by Stafford⁴ in 1839. Jolly,⁵ in 1869, collected 41 cases. The first careful tabulation of reported cases was made by Burckhardt,⁶ in 1902, who collected 24 cases. In 1908 Powers¹ reported a case, carefully reviewed the literature, and tabulated 22 cases. Von Frisch,⁷ in 1910, collected 35 cases. Descums,⁸ in 1912, gave an excellent review, tabulating 41 cases.

Of 58 observations which Proust and Vian⁹ made in 1907, they make four groups:

1. Secondary sarcoma	6
2. Doubtful cases	4
3. Probable cases, but lacking histological examinations	14
4. Absolutely certain cases	34

In conclusion the age of incidence; the rapidity of growth; the balloon-like feel of uniform consistency; the chief symptom obstruction to urination, strongly suggest sarcoma.

To the above list the author appends the following personally observed case in its entirety, as the apparent rarity of this condition would seem to justify its report.

The patient was thirty-three years of age, single, with a family and past personal history having no bearing on his present condition. He denied having had any venereal infection.

The present illness began May 15, 1916, when he first noticed that unusual straining was necessary to empty his bladder. Two weeks later marked the beginning of acute retention and of catheter life. For seven months he catheterized himself five times daily, on four occasions a small amount of blood being noticed. He had no pain in the lower abdomen, along the urinary tract, nor about the perineum. The bowels were regular. Urinary obstruction and loss of about 20 pounds in weight in nine months were his only symptoms.

General examination was entirely negative, showing a very well-developed and well-nourished man.

Rectal examination revealed a very large, smooth, elastic-feeling body, of uniform consistency, not tender, slightly larger to the right than to the left. The examining finger could not reach above

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it. It was bimanually palpable, slightly movable and limited in outline.

The left kidney was palpable, tender and seemed enlarged. The right kidney was negative.

Red blood count, 5,744,000; white blood count, 12,000. Wassermann negative on two examinations.

His urine was acid, 1.010, albumin double plus, sugar none, contained many pus cells, a few red cells and no casts. With the amount and duration of the retention, it was concluded that there was some back pressure on the renal secretion. The "Thalein" output in three days was as follows: A retention catheter was placed on the first day after the "Thalein" test.

	January 25th	26th	28th
1st hour ...	100 c.c. trace	170 c.c. 26 per cent.	475 c.c. 66 per cent.
2nd hour ...	50 c.c. 12 per cent.	100 c.c. 23 per cent.	175 c.c. 27 per cent.
3rd hour ...	25 c.c. 6 per cent.		
	175 c.c. 18 per cent.	270 c.c. 49 per cent.	650 c.c. 93 per cent.

This is striking evidence of the value of a retention catheter in this type of prostatic obstruction.

Operation (January 29, 1917).—Suprapubic incision. On opening the bladder a rosette two inches in diameter consisting of œdematosus-looking papillomata from pea to large bean size surrounded the inner urethral orifice. This came from the apex of the trigone. The main tumor could be felt bimanually beneath this.

The entire growth together with this rosette was readily enucleated as one piece (Figs. 1 and 2), leaving a very large cavity separated from the rectal cavity by a very thin wall which was not torn. Three purse-string sutures were placed, obliterating this cavity and controlling the bleeding. Closure with suprapubic and catheter drainage.

Post-operative care: Three-hour boric acid irrigation for first day. Removal of catheter on second day. On the fourth day a distinct fecal odor was evident in the urine, from the suprapubic tube. This continued for a week, with cloudy urine, and ceased spontaneously; no sign of urinary discharge into the rectum. Convalescence was uninterrupted and the patient was up about the ward, passing urine tissue only.

Cystoscopy six weeks after operation showed a completely healed prostatic urethra and trigone, with some large, bulbous œdema. At one place this appeared so large that a section was taken for examination, which, however, showed inflammatory through the urethra in two weeks.

The patient being a ward case, he was lost sight of, but three and one-half months after operation, he returned with marked recurrence in the prostatic region. His general condition, however, was very good.

Pathologic examination showed the tumor to be sarcomatous (Figs. 3 and 4).

FIG. 1.

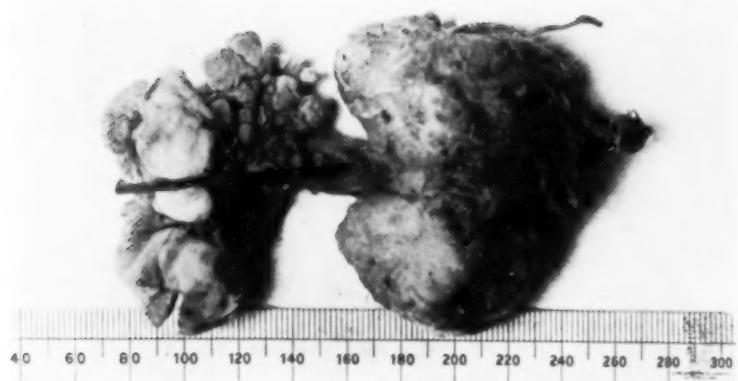


FIG. 2.



FIGS. 1 AND 2.—Showing gross specimens.

FIG. 3.

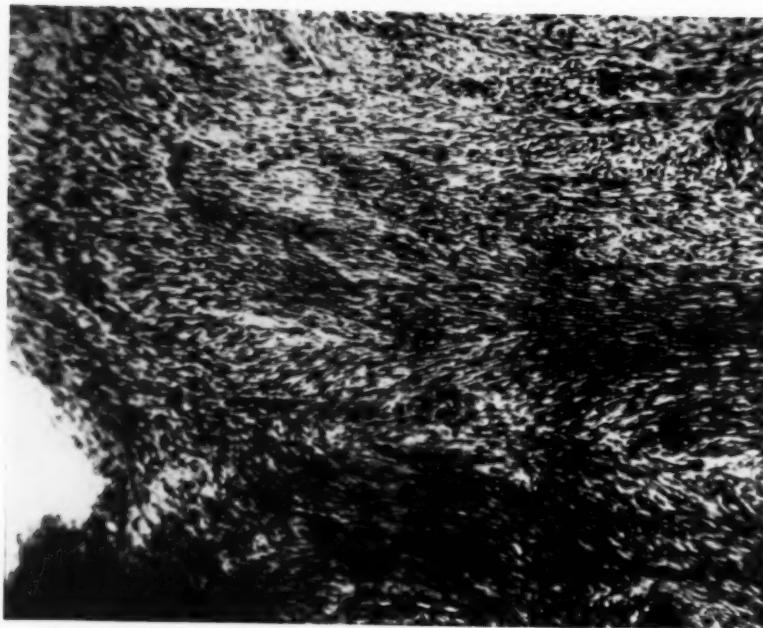


FIG. 4.



FIGS. 3 AND 4.—Microphotographs of tumor. Diagnosis: Sarcoma.

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Dr. B. B. Barringer of the Memorial Hospital in New York was kind enough to give him radium treatment.

The following is a report of the examination made by Dr. B. B. Barringer on May 15, 1917:

"Very large tumor can be felt. Growth of prostate on left side, possibly not as much on right side.

Physical Examination.—Well developed, well nourished young white man, not acutely ill. Pupils react sluggishly, breath foul, tongue fairly clean. Abdomen: normal above umbilicus. Between the umbilicus and the symphysis pubis there is a scar four to five inches long. About one inch from lower end of the incision the scar is spread apart by a circular scar as of abscess, the diameter of which is the size of a nickel. No discharging sinus. Around this circular scar as a center there is a hard indurated mass the size of an orange not very sharply circumscribed. The skin is freely movable over this mass, except at scar where it is adherent. The mass is not tender and there are no inguinal enlargements. Otherwise negative.

Treatment—Radium emanations. Needle inserted into the prostate, for six hours."

Autopsy by Doctors Ewing and Stone, July 12, 1917.

"Sarcoma of the Prostate—Metastases in the Liver. Suppurative Pyelonephritis.

Body—much emaciated. Decomposed. Skin—ulcerated over large tumor filling pelvis. Lungs—free, congested, normal. Heart—soft, normal. Spleen—normal. Liver—several large circumscribed, soft, yellowish, protuberant tumor masses $\frac{1}{4}$ cm. in diameter throughout the liver.

Pelvis—filling the pelvis, adherent to the walls of the pelvis and abdomen, and extending along the mesentery of the colon, forming a mass 15 cm. in length, surface lobulated, consistence soft and elastic, color yellowish, is a tumor mass emanating apparently from the tissues about the bladder. The tumor constricts the rectum. It is in places ulcerated and invaded by tumor tissues.

Bladder—mucosa highly inflamed. Invaded at one point from without by tumor tissue. Otherwise intact.

Prostate—missing. Tumor contains some dilated veins with thrombi and a few large cysts.

Kidneys—Both kidneys are the seat of intense suppurating pyelitis and nephritis in early stage.

Stomach—normal. Pancreas—normal. Genitalia—right testis small, hypertrophic, normal. Left testis—appears normal."

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ABSCESS OF THE PROSTATE *

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THE subject of abscess of the prostate may seem to many but a trite one, and undoubtedly the majority look upon it as principally a condition limited to the category of a complication of acute specific urethritis. That such is not the case but a cursory review of the literature is necessary. The interesting case of Lydston where the condition so closely simulated prostatic hypertrophy that even at suprapubic cystotomy it was unsuspected, and spontaneous rupture took place during a period of bladder drainage; or Harlow Brooks's case with its course so typical of enteric fever that for four weeks the true condition was completely masked, and more recently Bugbee's report of five cases seen as a complication of influenza during the recent epidemic, all show the deviation from the usual that prostatic abscess can manifest and broaden the field of possibilities calling for differential diagnosis.

Similarly in the short series of sixteen cases that it has been my opportunity to study, there have occurred certain features of unusual interest in diagnosis, making them worthy of a report at this time.

Prostatic abscess calls, in the first place, for an acute infection of the acini of the gland by a virulent organism of the pus-forming type, and we recognize in the beginning that this infectious process may manifest itself in four different degrees of severity, leading on the one hand to a limitation of the infection at any one of the stages, or, on the other hand, to a continuation of the process to a breaking down of tissue and the formation of an abscess cavity. These four forms of involvement from the time of the entrance of an infectious agent are: (1) The catarrhal, (2) the follicular, (3) the parenchymatous, (4) the periprostatic; and it is only when the infecting agent is overcome at an early stage that the process does not proceed from the one to the other with a culmination in the formation of an abscess instead of resolution.

During these periods of acute involvement we have but the palpating finger to guide us in interpreting the stage of the disease, and to determine when an actual pus cavity has formed. Here I cannot but feel that a close parallel can be drawn to a somewhat analogous infection; *i.e.*, acute epididymitis, where it was long considered that only infrequently did actual abscess cavities form, until Hagner, in operating upon all such cases, demonstrated that pus, in macroscopically visible quantities, was present in 80 per cent.; and as in epididymal so in prostatic infections, especially when gonorrhœal, is it probable that macroscopic pus is pres-

* Read before the Philadelphia Academy of Surgery, November 3, 1919.

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ent much earlier than now believed, and that early and free incision with drainage should be instituted as soon as diagnosis is made, so as to conserve the vital function.

It is the tendency of most physicians to feel in regard to prostatic abscess much as they do towards every acute ailment of the active generative organs in the male, that any infection of a pus-forming character is, *ipso facto*, of gonorrhœal origin: the contrary being shown by this short series of cases that I have personally observed is one of the interesting features to which I draw your attention.

The series comprise sixteen cases, eight of them were associated with the presence of the gonococcus and a history pointing to this infection being the cause of the abscess formation. An equal number, eight, were non-specific in their origin and form an interesting diversity of causes. Analyzing first those that were definitely post-gonorrhœal, we find that they, too, have interesting features that I will enumerate but briefly.

In one an interval of twelve years had passed since his acute urethritis, the patient had been married and left a widower, had during this time suffered from a mild, thoroughly chronic discharge, and after an alcoholic debauch, devoid of sexual exposure, he developed an acute urethritis. Gonococci were present, and shortly thereafter a prostatic abscess. Of these eight post-gonorrhœal cases but one was operated upon with drainage of the abscess. In four patients the course was uneventful, and early subsidence of all symptoms was followed by an apparent complete resolution without rupture. This was a most happy outcome for one of them, for he had multiple œsophageal strictures of small calibre from typhoid ulceration, and a urethral stricture of almost filiform size. In two others, who went to complete resolution, an acute epididymitis was associated and the prostatic involvement was especially marked on the same side as the epididymal. The remaining one where resolution took place was first seen under circumstances that countermanded operative interference. In the sixth post-gonorrhœal case, spontaneous rupture into the urethra occurred twelve hours after diagnosis was made, with a rapid subsidence of all symptoms. In the seventh, the abscess was purposely ruptured by a sound in the urethra—a most unsurgical procedure—and the eighth case was seen in consultation and lost to further study, although reported to have resolved without rupture.

So we have eight cases clinically diagnosed as prostatic abscess, secondary to an active gonorrhœal arthritis. One was operated and drained perineally; one was ruptured on a sound in the urethra; one ruptured spontaneously; four passed to complete resolution under local treatment, and one was lost to further observation. The series is too small to draw deductions from, but it does point out that there are varying degrees of pathologic involvement from this infecting organism. That in some with good judgment you can save your patient an operation, while in others resolution cannot be expected, and for them we know that it is better to operate and drain perineally than to allow urethral rupture. This group includes one where personal desire countermanded an operation definitely indicated. There was a large fluctuating mass in the left lobe, temperature of 102.5, white blood cells, 15,600, urinary strangury, chills, etc. Local treatment was instituted, two days later the temperature was falling, and

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the white blood cells were 14,200; the following day the temperature was normal and the white blood cells 12,400; and the next day it was down to 11,000 with the temperature remaining normal. His subsequent recovery was perfect, complete resolution followed, with certainly no rupture, and it has been surprising to see in the four cases so treated what rapid and complete resolution can take place. The right lobe was affected twice, the left lobe a similar number of times, and four times the involvement was general. Gonococci were present in seven cases from the urethral discharge, and were demonstrated in the one case operated upon.

Though the course pursued in these cases, with the exception of one, was non-operative, and though the results could possibly be used as an argument in favor of local, palliative treatment, the after-results oftentimes seen at intervals of years, from cases which were allowed to rupture into the urethra spontaneously, or to resolve with a chronic prostatic infection present, show conclusively that here, as in similar conditions elsewhere in the body, where pus has once formed, surgical intervention and proper drainage afford the patient a surer chance of a complete physiological restitution of function.

Frequently we see cystoscopically a condition in the prostatic urethra, first pointed out by McCarthy, where large scarified prostatic duct orifices penetrate to unknown depths into the gland tissue. These are now known to be the residuum of such infections, and as such form almost permanent foci of infection due to poor drainage and scar tissue, and incapable of ever returning to a normal state. Without doubt, such permanent damage may be avoided by early operative interference, and the degree to which such injury may develop will be illustrated by two of the cases about to be reported in the non-specific group.

In the second group of eight cases gonorrhœa played no antecedent rôle. These are by far the more interesting cases. The possibilities as to origin of infection, the type and virulence of the organism, the ofttimes complete masking of all symptoms pointing to the actual seat of the disease, the rapidity of some cases and the latency of others, make an ideal field for differential diagnosis.

Of these eight non-specific cases, instrumentation was responsible in four of them. The first consulted a specialist for a slight mucoid discharge. For a month he was given prostatic massage and "deep injections." Following one such treatment he developed within forty-eight hours all the symptoms of an acute infection of the prostate—there was a chill, fever, with a temperature of 103, haematuria, and vesical tenesmus. The diagnosis of an abscess was easily made by rectal examination. An acute epididymitis developed the following day. Palliative treatment was requested, and under local applications complete resolution took place slowly and without rupture of the abscess. In the second case, age twenty-eight years, there had been a gonorrhœa nine and two years previously. Three weeks before hospital admission, after a walk in the cold, he developed a chill and fever, with a temperature of 103, and pain in the right chest. Treatment was given by his physician and two days later the chest pain was gone. Ten days before admission he developed retention of urine following the passage of a sound, which had been unsuccessful and had caused bleeding. Pain began within twenty-four hours and

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steadily increased. On entrance to the hospital his temperature was 104, and his white blood cells 19,600. The entire prostate was involved in the abscess formation and presented a mass extending as high up as the finger could reach. Operation showed a large pus cavity especially located in the right prostatic lobe, with a marked indurated cellulitis extending all the way down into the right crus penis. The organism was the staphylococcus pyogenes aureus.

The third case was seen while in the field with the A. E. F.—a man, fifty-two years old, who had been told that he should have a sound passed every month because of an old stricture. His medical officer did this for him, and five days following the third passage of a sound there was a very gradual onset of acute symptoms, which in six days developed a fluctuating mass in the prostatic region. On account of surrounding conditions a palliative course was pursued for seven days in the hope that resolution would take place. However, at the end of this time the patient's condition demanded intervention, so under morphia and cocaine anaesthesia perineal incision and drainage were performed, and a complete recovery was obtained in seventeen days. This was a most satisfactory case, as an invaluable officer was saved to the division for tremendously important work at the front in the September and October campaigns. Unfortunately the origin was not identified.

The fourth (now a patient in the hospital) gave a most unusual history. He was doing some heavy work in the army when seized with a sharp pain in the right groin. Hernia (according to him) was diagnosed, but unoperated, and in three weeks he was well. Before leaving the hospital in October, 1917, he was ordered to take a permanganate of potash irrigation. He remonstrated, not seeing its necessity, and was ordered to do as told. Some bleeding followed this, and he had complete retention for five days, having a catheter passed once in each twenty-four hours. On the fifth day he was seized with chill, fever and severe pain in the rectum, and was immediately operated upon for prostatic abscess by a perineal incision. The patient states that he "came to" six weeks later in December, 1917, and was told that he was a bleeder, and had had two transfusions to save his life. He was then voiding through his perineal incision and his urethra. In January, 1918, a sudden hemorrhage from his incision called for a third transfusion. In March a catheter was passed and again bleeding occurred of such alarming character that a fourth transfusion became necessary. Following this he developed a left epididymitis, which suppurated and was incised, and following this operation he first passed urine per rectum. Typhoid at fourteen, scarlet fever at eight, several teeth pulled as a child with no hemorrhage, but in 1908 an extraction of a tooth was followed by bleeding requiring packing, and in 1915 had a severe "nose bleed," brought on by sneezing, which lasted four days. Had had an appendectomy the same year without incident. This patient had a fistula certainly a centimetre in diameter extending directly through his prostate into his rectum. Three-quarters of his urine went through the fistula. He had bladder continence. So with such a history and a coagulation time of thirteen minutes, he will be left alone.

Again we have a case of a boy of twenty-three years, who entered the dispensary complaining of his inability to properly control his urine. For many years, in fact, as long as he could remember, he dribbled urine, which he now says he knows to have been due to the overflow of retention. This he has relieved during the past few years by the judicious use of a catheter. One and a half years ago he developed a swelling in the right lower abdomen, practically symptomless, which finally ruptured and discharged a large quantity of pus through the urethra. During the healing of this condition there developed an opening into the rectum, for since that time, when he gets over-distended, urine in small quantities passes into the rectum. There is never any faeces or gas mixed with his urine. He has rectal control; in fact, is constipated.

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Cystoscopy (May 4, 1916): Bladder normal, urine slightly cloudy, left ureteral orifice not demonstrable. In the posterior urethra a large cavity was found extending back into the region of the right prostatic lobe, from which can be seen protruding a mass either fecal or calcareous. There is a small pocket also on the left.

Cystoscopy (May 12, 1916): Two calculi were found in the bladder. They were crushed with the cystoscopic rongeur. The prostatic cavity was clear.

Cystoscopy (May 19, 1916): Two more small stones seen in the prostatic pouch. These were picked up with the cystoscopic rongeur and placed in the bladder, where they were crushed at leisure.

Cystoscopy (May 24, 1916): Last calculi crushed. Reexamined January 17, 1917. Condition as before, no further stone formation. Patient is still using a catheter.

This boy's condition was due to *spina bifida*, demonstrated by X-ray, his sphincteric inhibitory fibres being undeveloped. His abscess was caused by his catheterization.

These last two cases illustrate the unfortunate results that may ensue from injudicious instrumentation, and the most distressing complication from prostatic abscess. In the former it was felt that so long as his vesical control was perfect from the good action of his internal sphincter, he had best be left alone, in the face of his history of bleeding. In the second, patient's undeveloped nervous system, though responsible for his trouble, was likewise considered his saving, as his spastic internal sphincter controlled his urine and any operative interference might make a persistent dribbler of him.

Again we have a student, thirty years of age, who during the preceding summer was studying abroad, and for recreation used to row a great deal, and as a result had a series of soills. The first were undoubtedly due to the rubbing of the boat seat—a condition so frequently seen in oarsmen—but they were succeeded by a series of similar infections elsewhere about the body, in several of which on culture the *staphylococcus pyogenes aureus* was the causative agent. About two and a half months after the first of these local infections, and after his return to the States, he was suddenly seized with rectal pain, chills, fever and a high leucocyte count. Prostatic abscess was diagnosed and operation proved the same to be the cause. The infecting agent was still the *staphylococcus pyogenes aureus*. No venereal infection.

The fifteenth case was that of a young physician. No venereal history. He had been in slightly lowered condition of vitality and health from his active rural practice, when he suddenly felt faint. Later he had a chill and was feverish. The only other promonitory symptom was that on the day before he had noticed some scalding on urination and found his urine scant and highly colored. He had been constipated for several days prior to these symptoms. His temperature was elevated on the above day of onset, and the following day it had reached 102, with pains down the legs, in the back and headache. There was a gradually increasing pain in the rectum. The following day, forty-eight hours from onset, after straining at urination there was a slight discharge, which increased rapidly at each urinary effort, and towards evening after one urination there was passed out a lump of mucus, followed by a profuse purulent discharge and blood. Condition from then on improved to complete cure. Smears from the discharge and also a culture showed *B. Coli Communis*.

The last case was seen on the Urological Service at the Johns Hopkins Hospital. The man was seventy-two years of age and gave a very typical history of gradual vesical obstruction due to enlargement of the prostatic gland over eight years' duration and with gradually increasing symptoms. Four days before his admission complete urinary obstruction occurred, associated with an elevation of temperature and very severe chill. Catheterization for the first time was easily performed, but without greatly easing the patient's discomfort. For fifteen days regularity of recurrent diurnal chills of the most intense type and subsequent

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fever elevation made the medical consultants feel practically certain that the patient had malaria, no matter what else he harbored, and this assumption was strengthened by the Virginia home of the patient, as also his past history. An elevated white blood-cell was against this diagnosis. Catheterization was easy, and even cystoscopy was performed. By rectum there was a large smooth prostate in no wise especially symptomatic or suspicious. He was treated expectantly. His temperature chart broke all the high and low records. At one time it varied from 96 at noon to 107.2 at 7.30 P.M., falling from there to 96.8 by 8 A.M., an excursion upward of eleven and two-tenths degrees and a fall of ten and four-tenths in the space of twenty-four hours. It was at this point that the surgeon stepped in, and knowing that there was urinary obstruction present—everything else being uncertain—started to perform perineal prostatectomy and drained a large prostatic abscess. The culture in this case showed *B. Coli*.

Summarizing the non-gonorrhœal cases: one underwent resolution; one ruptured in forty-eight hours into the urethra; four were operated upon by perineal incision; and two presented the sad after-results of such infections poorly handled in having a urethro-prostato-rectal fistula. In two cases *B. Coli* was the infecting organism, and in a similar number *staphylococcus pyogenes aureus*.

In regard to the mode of approaching a prostatic abscess for drainage, there are four possible and recommended routes: First, the purposeful rupture on a sound in the urethra, a procedure blind, dangerous, hemorrhagic, destructive, and non-surgical in the extreme. Secondly, the drainage into the rectum, again non-surgical, and because of the tension of the parts offering very poor drainage. Thirdly, there has been recently proposed a perineal incision into the urethra, followed by the introduction of the finger into the posterior urethra and digital rupture of the abscess through the posterior urethral wall. As above pointed out, the future repair of such openings is oftentimes the cause of persistent sinuses in the prostatic urethra and the cause of chronic prostatic irritation; moreover, the author of this recent article advocating such an approach drains by passing a tube into the bladder and allowing the purulent discharge to drain around this to the perineal dressing. Again I cannot refrain from calling this method non-surgical, for it certanly opens up avenues for the infection to spread that are absolutely unnecessary.

The choice, then, remains to expose the posterior surface of the prostate through the perineum, incise directly and under the eye's guidance the actual seat of infection, place therein tube and gauze drainage; the whole performed without injury to either the urethral or the rectal surfaces, they being left to perform their respective functions as usual, and without danger to their normal continuity.

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CERVICAL EROSIONS

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THE term cervical erosion, like many other names used in connection with this condition, such as mucous patch, cervical granulations, endocervicitis, cervical catarrh, etc., is not accurately descriptive of the lesion to be discussed. When applied to a pathological process the term erosion has ever suggested a raw or ulcerating surface, but such is not found present in the condition under consideration. Ruge and Veit first called attention to the adenomatous proliferation which takes place in the cervix, and later Eden and Lockyer have suggested that "proliferative adenoma of the cervix" would be a better and more descriptive term. The gross appearance of the cervix when presenting this condition resembles somewhat a granulating surface when viewed through the speculum. This fact has probably played an important part in maintaining the use of the expression.

In the normal cervix the line of demarcation of the external os is sharp between the mucous membrane lining the cervical canal and that covering vaginal portion. The former is composed of connective tissue over which is placed a single layer of columnar epithelium of the mucous type. The free margin of the surface is distended with secretion. Within the deeper portion of the membrane are found the cervical glands lined with the same type cell. These glands secrete a thick tenacious mucus into the lumen of the canal. In the foetus this columnar epithelium extends beyond the external os and it has been suggested by Fischel that the failure of this to disappear may account for the occurrence of congenital erosion.

Laceration of the cervix during childbirth is the most common cause of erosion. Rarely this condition may follow a plastic operation on the cervix whereby the normal anatomical relation between the mucous membrane lining the canal and that covering the vaginal portion is deranged so that the columnar epithelium is rolled out beyond the normal line of separation. The small abrasion or superficial tear seldom enters into the causation of erosion, since the squamous epithelium readily covers such surfaces. The deeper lacerations of childbirth which are more common than we are wont to recognize, and especially when bilateral or stellate, cause in most instances eversion of the torn lips so that the lining membrane of the canal becomes exposed in the vagina. When unrepaired the cervical membrane in most instances does not return to its former position. This misplaced membrane of the canal, which normally

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is bathed in the mildly alkaline secretions of the uterus, now comes into constant contact with the acid reaction of the vagina. Secondary infection, either acute or chronic, is a most common complication. The friction of the vaginal walls associated with the above mentioned sources of irritation produces an increase of the submucous stroma plus an adenomatous proliferation of the glandular structures. As the condition progresses the columnar epithelium tends to extend beyond the margins of the tear, carrying with it the mucous glands, so that their ducts open on to that portion of the misplaced mucous membrane now exposed within the vagina. The extent to which this occurs varies with the nature of the tear, the presence or absence of infection, and the length of time the condition is allowed to remain untreated.

Gonorrhœal infection of the cervical canal even in the absence of laceration may set up sufficient inflammatory reaction within the submucous structures to produce a swelling and œdema which will tend to push the membrane of the canal past the external os. As this becomes more and more chronic we find a marked increase in the number and size of the glands.

Under the microscope the area of erosion is covered with a single layer of columnar epithelium. The continuity of the surface is interrupted by the ducts of the glands. These glands become greatly enlarged and in some instances extend for a considerable distance into the underlying connective tissue. Very often they are of normal size, but considerably increased in number. In many specimens the glands are found dilated and filled with mucus—the columnar epithelium being swollen and distended with secretion. When this secretion does not find ready exit via the ducts of the glands the lining membrane may become flattened because of the increase in pressure produced with the increase of the material. An inflammatory reaction may or may not be found within the stroma. Eden and Lockyer have applied the term "follicular erosion" to the type of cervix which displays a retention of the secretion associated with a dilatation of the glands. They suggest "papillary erosion" for the type in which the increase in stroma tends to push outward villous or papillary projections covered with a layer of columnar epithelium. It is this type which strongly suggests a granulating surface when examined per vaginam. When both of the above types are found in the same cervix they would use the term "simple erosion."

Should a section of the cervix be cut for microscopic examination so as to show the junction between the true vaginal portion and the erosion proper, it will be noticed that the misplaced membrane bulges out past a sharp line of demarcation, while on the other end the process fades gradually into the membrane still lining the cervical canal.

The erosion in some instances after becoming more or less chronic tends to heal. The squamous epithelium in some cases extends over the area of erosion overriding the columnar epithelium in such a manner

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that it causes these cells to entirely disappear, resulting in a subsequent atrophy of most of the glandular elements. As this change progresses it is associated with a contraction of the stroma and there results a complete obliteration of the channels of exit with the formation of retention cysts, of varying sizes, to which the term Nabothian follicles has been applied.

To the examining finger the irregularity in contour of the cervix when lacerated can be distinguished readily. The erosion feels soft and velvety. This is even more pronounced in the distinctly papillary type which when viewed through the speculum resembles very closely a granulating surface. The surface is covered with a thick tenacious secretion. In the non-infected cervix the leucorrhœal discharge is clear and glistening or whitish and otherwise muco-purulent or purulent. Although the surface bleeds rather freely when manipulated with the finger or instrument, it is never friable. The condition when chronic presents a cervix which is more or less hardened and fibrous. If the attempt to heal has progressed sufficiently to cause the production of Nabothian follicles there is a shotty-like sensation transmitted to the examining finger. To the eye these appear as bluish thin-walled cysts extending beyond the surface of the cervix, and when punctured are found to be filled with thick mucus.

The most common symptom is leucorrhœa, varying in amount and color. The congestion attendant with menstruation tends to increase this discharge just prior to the appearance of the flow. Many patients complain of menorrhagia, which is due in most instances to an associated subinvolution of the uterus. The chances of the patient becoming pregnant are lessened. However, should this occur, abortion is not infrequent. When questioned the patient will usually state that she suffers from a sensation of weight in the pelvis together with one or more of the reflex disturbances encountered during the course of uterine pathology.

In differentiating this condition from malignancy it should be remembered that while erosion of the cervix bleeds rather freely, it is never friable excepting in those cases in which actual malignant change has occurred. When doubt exists a diagnostic section should be removed prior to performing a radical operation. Tuberculosis of the cervix is not of frequent occurrence, and when it does occur the lesion is softer, bleeds less readily, but has a tendency toward hemorrhage in the absence of examination. There may also be complete destruction of tissue with excavation of the cervical canal and vaginal portion of the cervix. During the later stages of tubercular infection the discharge becomes very profuse, purulent and offensive. The history and general appearance of the patient together with the findings in the gross lesion should render the differentiation comparatively simple. When syphilis is suspected the Wassermann and the history of the case should aid in clearing up the diagnosis. Here, as in tuberculosis, the tendency is toward destruction of tissue and not proliferation as seen in most cases of erosion.

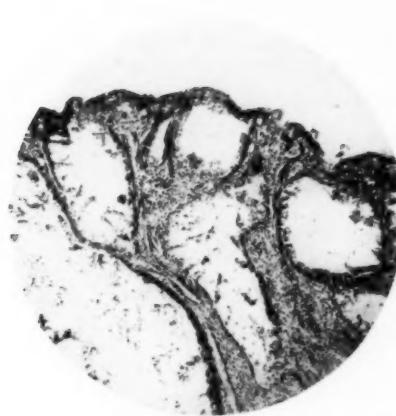


FIG. 1.—Low power.—Cervical erosion of "follicular type" showing marked dilatation and accumulation of secreted material.

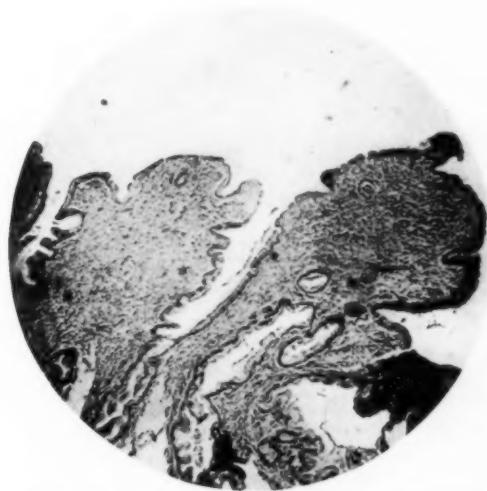


FIG. 2.—Low power.—Cervical erosion "papillary type" showing projections of stroma covered with a single layer of columnar epithelium.

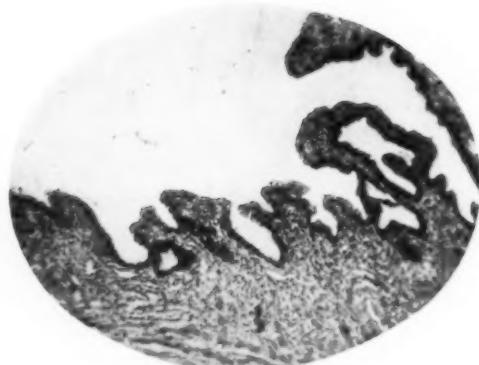


FIG. 3.—Low power.—Cervical erosion, "simple type," showing small papillary projections with dilatation of glands.

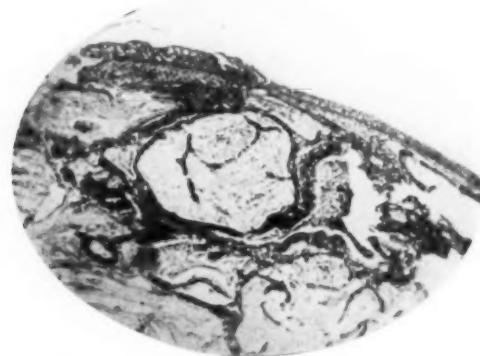


FIG. 4.—Low power.—Cervical erosion. Marked "follicular type" with beginning formation of retention cysts.

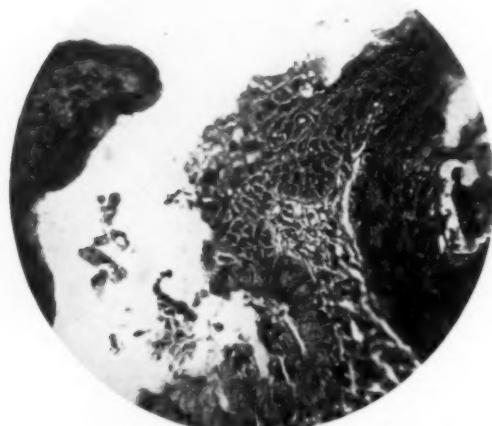


FIG. 5.—High power.—Cervical erosion showing attempt to "heal." Squamous epithelium is seen dipping down the side of duct in attempt to close over the area.

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The treatment of cervical erosion when seen early is rest. The patient is instructed to refrain from coitus. The local medication consists in combating whatever infection is present. In some instances it is advantageous to render the vaginal secretions less acid by the institution of some mildly alkaline douche as a daily routine. In certain cases chemical cauterization may be used with some improvement. Curettage has improved the condition in many patients. This procedure must be thorough and succeed in removing all of the damaged tissue so that the normal relationship of the structures entering into the formation of the external os is obtained. In some instances when the condition is of long standing associated with considerable tissue change, plastic repair of the laceration is indicated. When the process is markedly chronic and the cervix is fibrous and the clefts formed by the old lacerations are partially filled and surrounded with dense connective tissue, the treatment of choice is amputation with the formation of a new external os.

SUMMARY

1. The term cervical erosion, like many other names similarly used, does not adequately describe the condition.
2. "Proliferative adenoma of the cervix," as suggested by Eden and Lockyer, would seem to be a better and more descriptive term.
3. Three distinct types are encountered—the follicular, papillary and simple.
4. Nabothian follicles are formed when the process is undergoing an attempt to "heal."
5. Rest, local medication, plastic surgery and amputation of the cervix all have their indications in the treatment of the cervix.

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TREATMENT OF NON-UNION IN COMPOUND FRACTURES*

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THE treatment of non-union in fractures of the long bones has interested surgeons for many years. Since 1914 both our interest and our knowledge have greatly increased. At the present time there is still considerable controversy as to the proper methods of treatment. It would be impossible in any short paper to cover the various opinions that have been brought forward and it is my purpose only to give you some more or less related ideas on treatment of non-union following compound fractures due to war wounds. Although these cases differ from many that are seen in civil surgery, yet they closely resemble the type found in industrial surgery in that both show infection and marked destruction of bony and soft parts, combined with great functional loss. During the last half of the year 1917 I had the good fortune to be attached to the R.A.M.C. and to be stationed at the Military Orthopaedic Hospital at Shepherd's Bush and at St. Katharine's Hospital, London. At these hospitals were gathered the British war casualties that needed reconstructive work. Here were old cases dating back to the 1915 campaign on the Somme, as well as the fresh casualties of the Ypres and Passchendale battles. Here we saw the compound fractures in every stage of their treatment and of every sort—those that were healing by primary union, those showing delayed union, as well as the older non-union cases.

At both the hospitals it was our policy to classify a case as non-union only after every effort had been made to procure the results without surgical interference. And it may be mentioned in passing that many of the cases of delayed union, even those in which there was considerable separation of the fragments, united after prolonged fixation.

Many cases of non-union could have been prevented by better methods of fixation during the earlier stage of their treatment. Although I can give no definite figures, I feel convinced from the work that I saw first in England and later in France and in America, that the percentage of non-union in the casualties of the 1918 campaign was very much smaller than the cases injured in 1915 and 1916, and this is unquestionably due to the better surgical technic used at the C.C.S.'s, and especially to the use of Thomas splints, which gave such accurate alignment by fixation and extension and which were capable of being well applied by any of the enlisted personnel of the medical corps as well as by all medical officers. These two things, a skilful débridement with careful preservation of all possible fragments of attached periosteum and bone, and the accurate and

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prolonged maintenance of proper alignment, were the main factors in the prevention of non-union.

The cases of true non-union were due to infection or to extensive loss of bone substance caused either by the missile itself or by over-enthusiastic removal of bone fragments at the primary operation. The treatment of the cases divided itself into two distinct parts: First, the restoration of the function of the disabled limb, and, second, the treatment of the fracture. Both parts of the treatment are equally important, and I believe that we often neglect the rather monotonous and long-drawn-out functional restoration in our interest in the treatment of the fracture itself. An arm or a leg may be entirely useless from a false joint occurring in one of the long bones, but it may also be as much or even more disabled by the loss of a joint or muscle function that is usually found as a complication of the fracture. Good examples of this were the infected fractures of the arm. Finger motion and pronation and supination were almost invariably lost in these cases, even when the wounds were in the upper arm, and it was with the utmost difficulty that we obtained functional efficiency. Manipulation under an anæsthetic seemed to increase rather than decrease the disability. Prolonged treatment with splints that gradually forced motion combined with hot baths and massage gave us the best results. If this part of the treatment is delayed until after firm bony union is established, free motion of the joints distal to the fracture is almost impossible to obtain, and from the patient's standpoint his long stay in the hospital has been valueless because restoration of motion is the goal for which he was aiming.

Much of this disability can be avoided by early exercise—active whenever possible, passive only when the fracture is so low that active motion is prohibited. The good results of this early motion are well shown by the difference between the old cases of fractured humerus at Shepherd's Bush which had little or no attention paid to finger motion in the early stages of their treatment and similar cases which were treated at the Neuilly Hospital in Paris during the summer of 1918, and which had proper treatment started within a few days of their primary operation. At Shepherd's Bush 30 cases out of 40 showed marked loss of hand motion; while in France we had 100 consecutive cases of compound humerus fractures unite without loss of finger function.

During the pre-operative period in non-union cases, all systemic conditions which might interfere with union may be discovered and corrected, also the general nutrition of the injured limb can be greatly benefited by massage and hot bath treatment. In this period a short course of deep, heavy massage may be of great value in determining whether or not the scar tissue in the old infected areas is permanently healed. If a scar can withstand this heavy manipulation and can become less adherent and less red, it is safe to believe that operative procedures will not reawaken the infection.

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In regard to the length of time that should elapse between the closing of all sinuses and the operation for non-union, there is still a great divergency of opinion. During our first contact with these cases we were told by our British colleagues that it was unsafe to operate for at least one year after the infection had healed. Naturally both the patient and surgeon were anxious to cut down this period as much as possible, and we finally adopted a procedure which we believed would give the best results. Usually we allowed six months to elapse before considering operation. If the primary infection had been mild and of short duration, this six-months interval can safely be shortened to four or five months. On the other hand, if the infection had been severe and prolonged, nine or even twelve months should elapse before operation is considered. At that time a ten-day course of heavy massage of the scar was carried out. If the scar showed no reaction, operation was done. At this operation the scar tissue was dissected away both from the soft parts and between the bone fragments. Smears were made from the deep tissues and the wound was closed. If the infection was reawakened as it was in a moderate percentage of cases, the wound was widely opened and the infection was controlled by Carrel-Dakin, so that the period of the patient's convalescence was not appreciably lengthened. If, however, the bacteriologic report was negative for virulent pathologic organisms, and if the wound remained closed, a second operation was done within eight or ten days. This second operation consisted of the actual repair of the fracture. For this no one procedure can be advocated. However, it can be said that the simpler the operation, the better the result. If the bone ends can be freshened and brought into apposition without disabling shortening and can be held there by the use of catgut or kangaroo tendon, it is better to stop without the use of more elaborate procedures. If this is insufficient we have a wide choice of various types of metallic or bone plates, of many kinds of bone graft, and of wire, screws, pegs, etc. In making a choice from these various materials, it should be remembered that the tissues of these patients have not the resistance that is normally found in cases in civil surgery. Both general and local vitality has been lowered by the long battle against infection, and these operative wounds must be handled much more considerately than those in normal healthy individuals. Personally, I object to all forms of metal, either wire or plates. They act as irritants and cause bone atrophy at the place where we want bone growth. There can be no doubt that bone plates cause atrophy. Any series of X-rays will prove it. While at Shepherd's Bush I removed or saw removed at least a dozen bone plates which had been inserted for non-union. Not one of the cases had united. Four of the plates were entirely covered in by abnormal callus and were found lying loose in a cavity of the bone just as we so often found sequestra. I can remember only one case that succeeded in uniting on account of—or, perhaps, in spite of—his bone plate. I can also remember two cases that

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were plated a year or more after their sinuses had closed, that became very septic after operation. Both of these operations were performed by a surgeon whose technic was above suspicion. Major Kinder states that on his service in England he did a series of over 20 bone plates, and that "careful investigation later revealed that over 60 per cent. of these cases were complete failures either because active sepsis was stirred up or because the bones would not grow."

When some mechanical fixation is needed or when there is a bony gap to be bridged, the autogenous bone graft offers the best chances of success. Theoretically, the sliding type of graft is the best, but practically the graft from another healthy bone, such as the tibia or rib, seems to be of greater service. A graft to be successful must be snugly imbedded for a considerable distance in the healthy bone in both fragments. It should reach to the medullary cavity, it should preserve both its periosteum and endosteum, and it should be of healthy non-sclerosed bone throughout its whole length. It is hard to fulfill these conditions with a sliding graft. Therefore, a graft from healthy bone seems preferable. In the larger bones, as the tibia and femur, such large heavy types of graft work exceedingly well.

In the smaller bones, such as the radius and ulna, the small thin graft does much better. In the earlier parts of our war work we used a moderately heavy graft in these bones. Healing proceeded normally, and at the end of four or five weeks the operation seemed very successful. But at the end of the second or third month four out of my first five cases began to show thinning of the graft area, and this absorption continued until after the graft between the fragments had disappeared and the non-union had re-occurred. Whether this was due to a very low grade infection, or whether the graft was so large as to interfere in the blood supply, I am unable to say. I only know that the operations at the end of four months were failures. I have had reports from other surgeons who have had similar results. In subsequent cases, at the suggestion of Doctor Chutro, I have used a very thin, flexible graft, approximately $\frac{1}{8}$ of an inch thick, covered with plenty of periosteum, and laid sub-periosteally in a shallow channel dug in cortex of the bone ends. Whenever possible this graft extended for two inches beyond the sclerosed portions of fractured bone ends. The graft is held in place by suturing the periosteum of the bone over it. This type of graft does not give good bony fixation, but this is hardly necessary in fractures of the lower arm. It does give a bridge that stimulates bone repair more readily than does the larger type of graft. I have been able to check up only a few of my own cases, but have succeeded in retaining bony union for periods of at least six or seven months. From conversation with some of the British and French surgeons who were interested in this work, I feel sure that the thin, flexible type of graft in the smaller long bones is advocated by them.

I have made no attempt to cover the whole subject of the treatment

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of non-union. I have desired only to mention certain details of the treatment for your consideration and discussion, emphasizing especially, first, the need of early and efficient restoration of function of the whole disabled limb; second, the advantages of the two-stage method of operation on the old infected cases, and third, the usefulness of the Chutro type of graft in fractures of the smaller bones.

DISLOCATION OF THE TARSAL SCAPHOID: DOUBLE FRACTURE OF THE ISCHIATIC TUBEROSITIES *

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DISLOCATION OF THE TARSAL SCAPHOID

FRACTURE following violence is much more common than is dislocation of the bones of the foot. This is a splendid illustration of the law of Colles who observed that when the tensile strength of bone and ligament was put to the test, the bone usually gave way first. But despite the great strength of the ligaments which bind the component bones of the foot, dislocations of individual bones may and do take place, although fracture of these spongy bones occur much more frequently than do dislocations.

Dislocation of the tarsal scaphoid alone is the rarest of all varieties of foot bone dislocations. The security of position possessed by this bone is due to its anatomical relation with other bones, ligamentous, muscular and fascial supports plus the usual mechanical lines which force requisite in the production of these dislocations usually travels. Although the navicular is not the true keystone of the anteroposterior arch of the foot, it is accurately buttressed by a semicircular facet over the head of the astragalus and firmly held in position by the dorsal, plantar and interosseous ligaments. The tibials, peronei, flexor hallucis, flexor digiti and plantar fascia all lend additional support in maintaining this bone in position.

The inferior calcaneo-scaphoid ligament is one of the chief anatomical factors in maintaining the arch by supporting the head of the astragalus through holding the scaphoid in place; the function of this ligament receives additional support from the tibialis posticus, the tendon of which splits into numerous fasciculi which are attached to most of the metatarsal bones. The muscles concerned in supporting the articulations of the scaphoid are supplied by the anterior tibial nerve, hence injury to this nerve or impairment of function of the muscles supplied by it will favor destruction of the arch.

Dislocation of the scaphoid alone may be regarded as a traumatic flat-foot, and we may perhaps gain a clearer insight into the pathology of this dislocation by a brief reference to the mechanism in the production of the deformity so frequently encountered, called flat-foot.

Indeed, one very competent clinician has said that tarsal scaphoid dislocation never occurs in a foot possessing a natural arch. In flat-foot we

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have eversion and abduction of the foot with loss of both the transverse and longitudinal arches in consequence of the unsupported head of the astragalus which is permitted to point downward.

Owing to the lack of support from the articular surface of the scaphoid, the foot turns outward, increasing the inner side length of the foot and broadening its plantar surface. This condition is due to weakening of the tibialis anticus and posticus, the peroneus longus, and yielding of the internal, lateral, calcaneo-astragaloid ligaments and plantar fascia. This is essentially what occurs in scaphoidal displacements with this difference: one is of slow development and may be unaccompanied by pain; the other is sudden in origin, very painful, and has lacerated ligaments and the additional dorsal surface deformity incident to the misplaced scaphoid.

In a lax condition of the calcaneo-scaphoid ligament in the standing posture the weight is supported by the tibial muscles, and, although the ligaments limit the range of joint motion, the normal strain of weight bearing falls on the tibial group of muscles. The range of motion in the articular surface of the scaphoid under normal conditions is slight and limited to movement of the inner margin of the foot up and down; turning in and out of the toes has been erroneously attributed to mobility in this joint, but these motions are chiefly dependent upon the hip-joint for their accomplishment. From the intimate relation, with its anatomical surroundings, it becomes apparent that one of three routes is open for uncomplicated luxation of the scaphoid: dorsal, mesial and plantar. Outward dislocation of this bone would necessarily involve displacement of the cuboid and perhaps also the astragalus and calcaneus. Rupture of the interosseous ligaments and rupture or separation of the fibres of the calcaneo-scaphoid ligament must take place before the bone may be completely detached from its position in inward dislocations, and it is this separation of the fibres of the calcaneo-scaphoid ligament and the tendency on the part of the scaphoid to rotate on its horizontal or vertical axis which renders replacement of the bone difficult or impossible without open operation.

Failure to reduce luxation and the necessity of excising the bone has been encountered in the open operation in a number of instances.

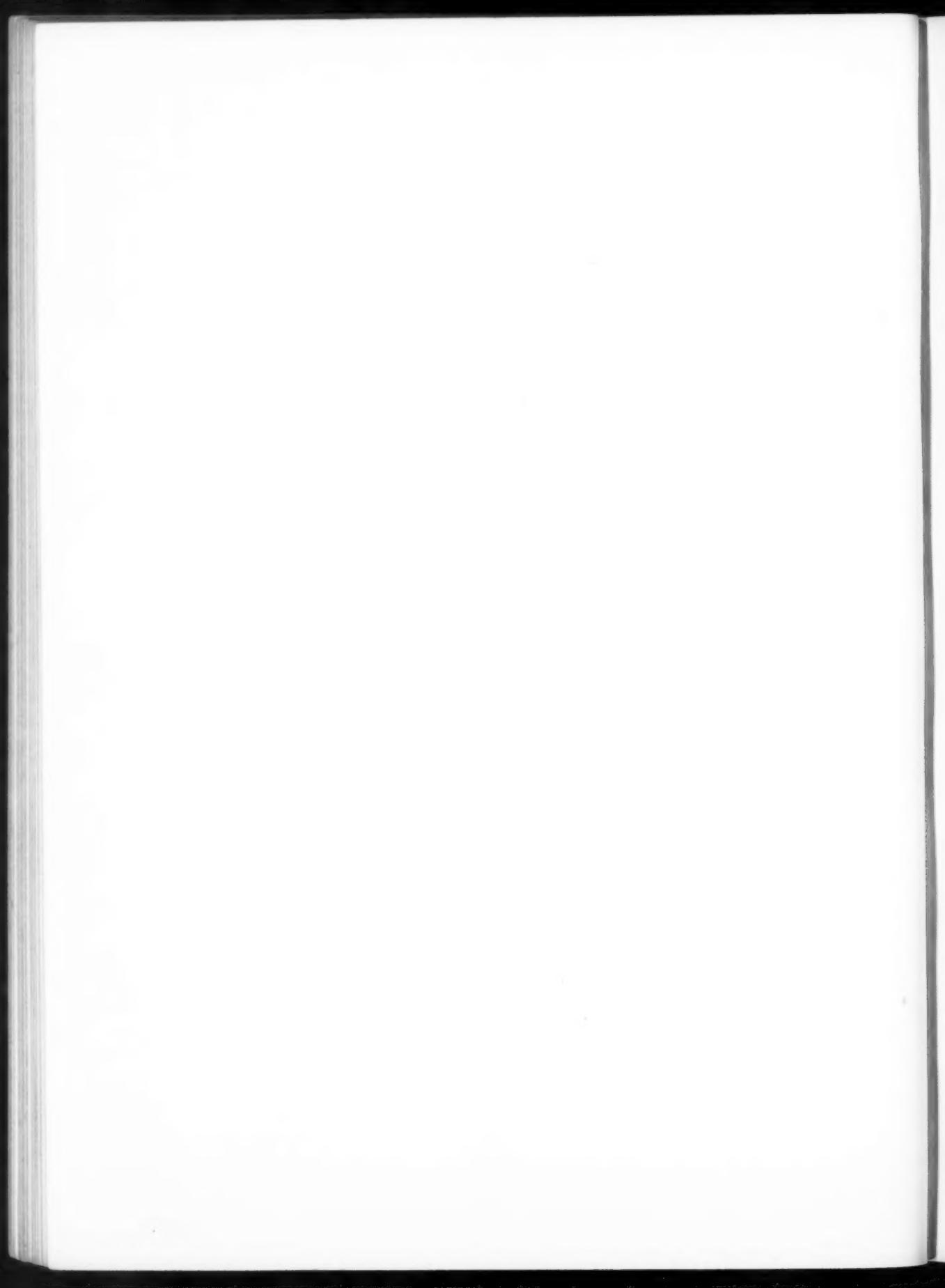
Malgaigne refers to scaphoid dislocation as a middle tarsal dislocation and Sir Astley Cooper in his work on dislocations gives a very accurate picture of the deformity in his report of a case of luxation of the navicular bone.

Stimson, 1910 edition, records 5 cases forward on dorsum, 1 inward and forward, 1 inward, 2 downward and 1 outward on dorsum; 2 reduced without, 2 with operation, 3 unreduced, 1 excised, and 2 amputations for gangrene.

Speed, in 1916, "Fractures and Dislocations," collected the records of 43 cases of dislocation of the scaphoid; to this list he added the record of a personal case, making a total of 44 cases, which he classifies as follows:



FIG. 1.—Showing dislocation of scaphoid.



DISLOCATION OF THE TARSAL SCAPHOID

Luxation of the naviculare cuneiform separations, 15; talo naviculare separations, 17; and total separation, 10; his own case added to the last class, making a total of 11 cases wherein the bone was wholly displaced from its normal moorings.

The *Index Medicus* contains no record of scaphoid dislocation since 1916.

CASE No. 15333.—(Referred by Dr. R. H. Whallon.) Male, age 51 years, laborer, well developed, 5 ft. 11 in., weight 180 lbs. While hoisting a tank with an I-beam and chain, the chain slipped, causing the I-beam to be displaced, whereupon the beam and chain, the combined weight of which was estimated to be 600 to 700 pounds, fell, and in falling struck the patient a glancing blow on the left side of the head and chest, forcing the patient into a sitting posture with part of the apparatus resting on his left foot.

When admitted to the hospital the foot and ankle were considerably swollen, the patient showed a mild degree of shock and complained of severe pain present in the left chest and ankle.

Examination revealed, in addition to multiple bruises and abrasions, fracture of the seventh, eighth and ninth ribs on the left side and a protuberance on the inner side of the left foot in front of the head of the astragalus. Crepitus was distinctly felt while examining the foot. An attempt at reduction by the attending physician had partially reduced the deformity.

The clinical diagnosis was fracture of the seventh, eighth and ninth ribs; dislocation of the tarsal scaphoid. Fracture of one, undetermined, of the bones of the foot.

X-ray examination at this time by Dr. Lange confirmed the presence of a dislocated scaphoid (Fig. 1), but failed to reveal a fracture. The general appearance of the foot was that of an exaggerated flat-foot. The head of the astragalus could be distinctly felt on the surface of the foot, the toes were directed outward, the outer side of the foot was turned upward.

The protruding scaphoid was firmly fixed and could not be easily moved, neither would the hollow space recently occupied by the bone admit the tip of the examining finger although a sense of absence of bone at the plantar site could be detected. The foot and ankle were steeped in hot saline solution for 24 hours, at which time the patient was etherized with a view to reducing the luxation. The scaphoid could now be moved for a short distance in all directions, the outward direction of the toes and other deformities could also be increased by slight manipulation. With the leg and thigh in a position of full flexion the heel of the injured foot was placed on the margin of the foot of the operating table and firmly fixed by an assistant. A leather belt three quarters of an inch in width was thrown over the foot by a second assistant with a view to forming a fulcrum pressing against the displaced bone.

Seizing the heel with the left hand and the toes with the right, the injured foot was forced into a position of extreme extension and while in this position the assistant made firm traction on both ends of the belt in an upward and outward direction. The foot was now quickly placed in extreme flexion at which time the scaphoid slipped back into place with an audible thud. When the foot was released and the belt pressure removed, partial dislocation followed which was easily corrected by pressure with the thumbs. The foot was dressed in a position of semi-flexion and slight inversion, with a plaster-of-Paris case which extended well up to the knee.

The dressing was continued for six weeks and the patient was permitted to get out of bed and on crutches at the end of ten days.

Although the patient could not use the injured foot until after the reduction of the luxation had been accomplished, the functional result is very good, three months having elapsed since the receipt of injury.

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DOUBLE FRACTURE OF THE ISCHIATIC TUBEROSITIES

Viewed from an anatomical point the pelvis is the strongest bony cavity in the body. Force requisite in the production of fracture of the pelvic bones and continuance of the force after the bone gives way is relatively so frequent that extensive damage to the urethra, bladder, intestine and blood-vessels is the rule rather than the exception in this type of fracture. Search of the literature did not reveal the record of an uncomplicated case of fracture of the tuberosity of the ischium, although some of the textbook authors speak of the possibility of such fractures. Fracture of the tuberosity of the ischium is an unusual occurrence and might be said to be the most infrequent variety of pelvic fractures.

CASE RECORD No. 13842.—A farmer, aged 33 years, seen in consultation with Dr. B. K. Menefee. Was thrown to the ground from a wagon, landing squarely upon his buttocks, in which position he was dragged some distance. When admitted to the hospital the patient was suffering from a certain amount of shock and complained of an agonizing pain in the region of the anus. Under full anaesthesia the finger in the rectum encountered a hard mass in either ischiorectal fossa. The mass in the right fossa was easily moved by placing the opposing thumb of the examining hand over the site of the ischiatic tuberosity and making a lateral motion. This manipulation elicited crepitus.

The mass on the left side was larger, more firmly fixed and required more force in moving it, but this movement also elicited crepitus.

There was a considerable displacement of the fragments inward toward the rectum and upward toward the tip of the coccyx. So far as could be determined the rectal wall had escaped injury and the urine was free from blood.

It was concluded that there was present a double fracture of the ischiatic tuberosities. The fragments were replaced, in apparently complete alignment, by the same method which had been employed in examining the patient. A plaster-of-Paris spica was applied and retained for six weeks. Radiographic examination showed simple fracture of the right tuberosity but the fracture line on the left side, after separating the tuberosity, continued through the ramus and body of the bone into the wall of the acetabulum.

Complete functional recovery followed and there is no apparent deformity.

SUTURE OF WAR WOUNDS*
BY DRURY HINTON, M.D.
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I. Organization.—In dealing with war wounds it is necessary to remember that here the great problem is infection, and in combating this we are taking the biggest step forward in preparing the wound for suture. If it is borne in mind that war wounds differ from civil ones more in quantity than in quality, it will be easier to arrive at a safe and sane method of treatment. Hence, with the kind permission of the Deputy Director of Medical Services of Rouen, we established a hospital within a hospital for the care and treatment of cases suitable for suture. For this purpose, one ward was converted into a clean operating theatre, and one ward of forty-one beds and two tents of a total of sixty-two beds were turned over for the reception of suture cases. Patients with wounds of the legs and trunk were kept in the wards, and those with wounds of the head and upper extremities in the tents.

The cases that were admitted to this department were: (1) Those coming down the line marked D.P.S., *i.e.*, supposed suitable for delayed primary suture. (2) Those whom the ward surgeons thought suitable for suture with minimum of treatment. (3) Those sutured in the "old theatre," and sent for observation. (4) Those excised in the "old theatre," and in the judgment of the operator suitable for delayed suture, and (5) walking wounded whose convalescence excision and suture would shorten. The last, in my judgment, was the most important class (from the military standpoint) that we handled, and the class previously most neglected.

These patients (with the exception of the operative cases) were dressed by myself immediately, and appropriate treatment instituted. In the beginning each case had a colored tag (either yellow or purple) given him, and the pathologist making his rounds would culture every day the alternate color. Later on, as clinical judgment improved, all cultures were taken in the theatre just prior to operation.

Dressings were done instrumentally and with scrupulous attention to aseptic technic, each case being treated as if heavily infected, as, strictly speaking, many of them indeed were. Should a case become unsuitable for suture or a sutured case infected, such a one would be immediately

* The work in this paper was done between the dates of August 7 and October 27, 1918, at Base Hospital No. 4, Rouen, France. I wish to express my appreciation to Dr. George W. Crile, for the opportunity to do this work, and for the helpful suggestions which he, from time to time, contributed during its course.

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transferred. Thus cross infection was avoided. Temperature and pulse were taken on all cases three times a day.

II. *Types of Wounds*.—For the sake of simplicity and adaptability for war use, wounds were classified for the purpose of suture into three groups, *viz.*: (1) Primary excision and suture. (2) Delayed primary suture. (3) Secondary suture or excision and suture.

1. By wounds for primary excision and suture are meant those wounds which have had no previous surgical interference. They will be suitable immediately or after appropriate treatment, for excision and closure.

2. By D.P.S. is meant that kind of case, operated upon at the Casualty Clearing Station (C.C.S.), so carefully that it is, in the opinion and judgment of the operator, suitable for closure in one to three days. He so marks it and evacuates it to the base.

3. By secondary suture or excision and suture is meant all cases operated at C.C.S. or Base that are suitable for closure in a few days or after epithelialization are suitable for excision and suture. In fact, it includes all cases other than (1) and (2).

III. *Preliminary Treatment*.—1. (a) Certain superficial and lacerated wounds in the absence of fever or local inflammation are treated by immediate excision and suture. The results are good.

(b) Where there is a local inflammatory reaction of mild degree, shown by a dusky red epithelial edge, it has been deemed advisable to treat the wound with methyl alcohol twice a day until charring or dryness of the wound is present (though one could probably get a good result by wide excision, yet it is highly desirable to save as much skin as possible). The charred brown crust is a good guide (in operating) to the extent of dead tissue present. It is a well-established fact that a dry wound does better than a moist one.

(c) Certain wounds with acute inflammatory reaction and fever are treated with hot dressings (or fomentations) consisting of gauze and lint wrung out in boiling water and applied at the maximum temperature that the patient will stand. The part is then wrapped in jaconet. The dressings should extend wide of the wound. When the temperature falls and inflammation and discharge decrease, methyl alcohol is used to dry up the wound. This process of applying hot dressings is done every four hours, and is necessarily time consuming. In rush periods it has been found advisable to use hot dressings during the day and to apply an alcohol dressing at night, to be removed in the morning when hot dressings are resumed. The combination is a good one and diminishes the maceration of skin surfaces. Hot dressings should be discontinued as soon as possible.

By these methods the average wound should be ready for excision and suture in from three to five days. Cases that did not improve were relegated to class 2 for treatment.

2. Treatment here should be the minimum. If fever and any consid-

SUTURE OF WAR WOUNDS

erable amount of discharge is absent, packing and dressing next to the wound are not disturbed. If for any reason packing is removed, it is well to apply hot dressings for one day to develop a local reaction and re-establish defense. A local leucocytosis is produced, which bars the spread of infection and tends greatly to control the infection already there. This may be useful prior to excision for the same reason.

I find it preferable to use dry dressings where possible. Where inflammation and fever are present they are treated by the usual means. Where fractures are present, hot dressings are indicated up to time of operation.

The question arises—How much of the wound should be excised at the front?

If after-results are to be considered, only the obviously dead tissue should be removed. The more carefully the dead tissue is removed and the more thoroughly all recesses are explored, the better are the results. As much skin as possible should be preserved, so that subsequent delayed primary suture can be done.

And again, should all loose pieces of bone be removed from compound fractures at the front? Probably not. Those pieces that are detached or obviously infected must come out. Adequate drainage is the main consideration. It were better to leave in numerous pieces with adequate drainage than one piece without it.

Another point to be decided is the best treatment to be started on débrided wounds at the front, and carried out until the patient reaches the base in order to give the best results insofar as early suture of the wound is concerned. Flavine gauze seems to have been the most popular and to have given the best results. Flavine is a mild antiseptic and the patients on whom it is used travel comfortably, and arrive at the base with red healthy wounds. After infection is established flavine is *useless*.

Paraffine gauze has given satisfactory looking wounds also.

Carrel's irrigation as a travelling treatment has been a disappointment, and the wounds reaching the base that have been so treated are the most hopeless, nasty, soggy messes that can be described. Carrel's cases should not be moved until the work of wound disinfection has been accomplished. On the ambulance train the irrigation is irregular, tubes pull out and the dressings become a moist warm culture tube.

Where B.I.P. has been used, results are fairly good.

3. These cases are treated according to indications outlined above.

IV. When is a Wound Suitable for Suture?—In my experience, three days after operation is the ideal time for delayed primary suture, since prior to this time tissue resistance is not sufficiently established, and after that time infection is apt to occur.

A red, slightly moist wound that bleeds slightly when the dressing is removed, is ideal for suture.

Contraindications are: 1. Inflammatory reactions. 2. Serous discharge.

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3. Malodor. 4. Fever. 5. Tension when coapted. 6. Multiple wounds on a very sick patient. 7. Anatomical inability.

V. *Anæsthetic*.—The anæsthetics used most frequently were $N_2O + O_2$ and ether. Primary chloroform was used in thirteen cases for primary excision and suture. Local anæsthesia was used when wounds were small and time not pressing. $N_2O + O_2$, or local with novocaine are to be preferred where practicable, since the patients, as a rule, suffer little pain and require little time for the operation, and where $N_2O + O_2$ is used it is easy for a surgeon to keep three or four tables running continuously.

VI. *Scrub-up*.—The skin is scrubbed with soap and water, shaved, washed with sodium bicarbonate solution, ether and alcohol, and painted with iodine. If packing is present, it is left *in situ* up to this point. Then it is removed and a culture of the wound taken.

VI-a. The clean suture theatre was equipped with a small sterilizer, 5 operating tables, and 4 "set-up" tables. For each table there was a small wire net tray with handles. In each tray were placed 4 Halsted haemostats, 2 Ochsner straight forceps, 2 Parker knife handles, 2 blades for same, 1 pair surgical scissors curved on the flat, 1 full curve and 2 half curve large surgical needles, 1 or 2 thumb forceps, 1 needle holder (Crile), 1 small roll fine silk, 12 sutures of silk-worm gut, medium. On the table were 1 tube of o catgut, sponges, dressings, 2 or 3 towels and small bowls of iodine and methyl alcohol. After each new case was finished, the tray was removed and re-sterilized, but the table did not need to be touched.

From the beams there were small rubber loops used for suspending arm or leg.

Operate on the stretchers, if necessary.

VII. *Operative Technic*.—In classifying operative wounds for sake of simplicity they are divided into: First degree or involvement of skin and subcutaneous tissue. Second degree or involvement of soft parts. Third degree or involvement of bone.

1. In the smaller wounds for primary excision and suture, prepared by hot dressings and alcohol, an elliptical incision is made, saving as much skin as possible, but going outside of any skin redness, removing the desiccated surface *en bloc*—the knife at no place touching the wound. Unnecessary sponging is avoided, fingers are kept *out of* the wound, hemorrhage is controlled by the sutures and pressure.

Sutures are, if possible, passed entirely under the wound surface, and, before the last stitch is tied, firm pressure is put on to remove the blood. An alcohol dressing is applied. The palm of the hand then exerts pressure on the wound for five minutes and the outer dressings are applied.

2. In deeper wounds, as little tissue as possible is removed in order not to open up new channels for infection. Fascial tags and small areas of necrosis are excised. These wounds have been closed as late as the sixth day without excising the epithelial edge. In these wounds, three objectives, and only three, were considered vital, namely: the obliteration

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tion of all dead space, coaptation with the least possible tension, and as little use of ties and buried sutures as possible, for it was observed that many of the cases coming down the line showed areas of necrosis at the site of the ligatures around vessels.

Alcohol, Dichloramine-T and iodine have been put into the wound prior to suture, but results have been no better than if no antiseptic was used. Dead space is obliterated by tension sutures rather than by buried sutures of catgut. Where this is impossible drain by silk-worm gut or B.I.P. and close loosely. Alcohol or dry dressings are applied. Deep bite on the skin edge is taken.

If there is bone injury in any one of these classes, the bone ends are freely exposed, clots in the shaft removed, and the ends cleansed and bipped. Immobilization by splint, posture or both are rigidly adhered to.

3. Antiseptics are of more value here, and handling and operative technic should be reduced to a minimum. Many compound fractures were successfully converted into simple fractures by this method.

VIII. Post-operative Treatment.—In the absence of fever, the dressing is not removed until the fourth day after operation. Fever the night following operation is usually reaction and means little. Fever the next morning is more significant and almost invariably denotes infection. At this stage, hot dressings continued for a day or two will usually clear up incipient infection without the sutures having to be removed. When infection is established around a suture, the sooner the stitch is removed the better. *A stitch in time saves nine!*

On the fourth day after operation, another alcohol dressing is applied. The wound is not touched again until the day the sutures are to be removed, which for the face and scalp is two to three days, the shoulder, buttocks, thigh, calf, nine days; other areas from seven to eight days. It is well in larger wounds to remove part of the stitches on one day, the remainder on the tenth day.

If infection is going to occur, it will usually appear on the second or third day, though occasionally as late as the sixth day. The larger wounds may have hot dressings for several days following operation. Posture and splinting are valuable. Sutures have been removed for P.U.O., mistaking the fever for that of infection.

IX. Results are classified as:

(a) Success—where the object sought is obtained, whether that be a complete or partial suture.

(b) Partial success—where less than half of the sutures show stitch abscesses, or where separation of part of the wound occurs.

(c) Failure—infection of more than half of the sutures.

X. Failure or partial failure has been dependent upon the following factors: (1) Failure to obliterate dead space. (2) Tension on the sutures. (3) Both. (4) Incomplete excision. (5) Presence of infected wound in vicinity.

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TABLE I
(Results All Under Battle Conditions)

Total 270	S.	228	84.43%
	PS.	32	11.87%
	F.	10	4.7%
Of 228 S.	I.	54	23.68%
	II.	135	59.22%
	III.	39	17.10%
Of 32 PS.	I.	7	21.87%
	II.	16	50.00%
	III.	9	28.13%
Of 10 F.	I.	1	10%
	II.	6	60%
	III.	3	30%
Of 62 I.	S.	54	87.1%
	PS.	7	11.3%
	F.	1	1.6%
Of 157 II.	S.	134	85.4%
	PS.	17	10.8%
	F.	6	3.8%
Of 51 III	S.	39	76.5%
	PS.	9	17.6%
	F.	3	5.9%

It can be seen from Table I that wounds of the skin and subcutaneous tissue are closed more successfully than those involving muscle. Wounds involving bone did least well. Only 30 per cent. of the failures were in bone injuries, but these three were in a total of 51 or 5.9 per cent. of all bone wounds, whereas the 60 per cent. of the failures that occurred in muscle injuries were only 6 out of a total of 157, or 3.6 per cent. There was 1 failure to every 62 wounds of skin, to every 26 wounds of soft parts, and to every 17 wounds of bone.

TABLE II
(Results All Under Battle Conditions)

Excision and sutures	112	S.	98	87.5%
		PS.	10	8.9%
		F.	4	3.6%
Delayed primary suture ...	124	S.	106	85.5% (30 unsuitable,
		PS.	15	12.1% 24 evacuated)
		F.	3	2.4%
Secondary	34	S.	24	70.6%
		PS.	7	20.6%
		F.	3	8.8%

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In Table II is shown the difference in results obtained in primary excision and suture, delayed primary suture, and secondary excision and suture.

TABLE III
(Results All Under Battle Conditions)

Suture Theatre	S.	178	85.6%
	PS.	23	11.0%
	F.	7	3.4%
Old Theatre	S.	50	80.7%
	PS.	9	14.5%
	F.	3	4.8%

In Table III are compared the results secured in the Suture Theatre where everything was under control and in the old theatre which received septic as well as clean cases. Though the number of cases is small in the second group, yet the effect is evident.

TABLE IV
(Results All Under Battle Conditions)

Amputation	S.	P. S.	F.
Forearm	4	0	0
Arms	1	0	0
Legs	1	0	0
Syme's	1	0	0
Thigh	0	0	1

In Table IV are the results of amputations sutured by delayed primary suture. The failure resulted in leaving the knee bursa in the flap.

Discussion.—These patients with wounds of lower extremities and trunk have been kept in bed until the stitches have been removed. It cannot be too much emphasized that wounds around the shoulder and scapular region do not do as well on ambulatory as on lying patients.

Does excision and suture save wastage of man-power? In the experience gained from twenty-three months' observation of walking patients it has been apparent that the most trivial appearing wounds have often taken several weeks to heal. Particularly is this so over bones close to the surface; for example, shin, joints, and active muscle parts. Excision and suture has sent these men to convalescence camp in ten days, and there were times in March and April, 1918, when every man counted.

Other results obtained have been: (1) Shortened convalescence. (2) Saving of hospital space, especially ward space. (3) Saving of dressing materials. (4) Lessening of disability by closing the gap to be filled in by scar tissue. (5) Cosmetic.

Wounds should not be closed unless they can be continuously under the care of the operating surgeon until the wounds are healed. If it is necessary to move a sutured case before completely healed, he should be

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evacuated at once and not on the third or fourth day when infection may be spreading.

In the case of knee-joints and tendon sutures, it is wise to leave the skin open at the first closure operation and to close on the third or fourth day.

Leaving in untied sutures to be closed subsequently is a bad procedure. They may become infected and delay closure. They are foreign bodies and a handicap.

Clinical judgment is sufficient to close a wound.

It is better to close a portion of the wound or to close the whole wound and have part or even half of it break down, than to do nothing. Though theoretically you may fail, yet actually you have lessened the amount of surface that is absorbing toxins. Should the whole wound break down you have done the patient, as a rule, no harm other than a few days' delay. In some knee cases and huge wounds of back and thigh with wide gaping muscles and loss of much skin, where anatomically closure has seemed impossible, by three or four partial closures at three or four day intervals, the wounds have been entirely approximated.

Many of the wounded objected to having their wounds closed, inasmuch as they were returned to duty sooner, and missed their sick leave. This difficulty was overcome by granting the men a short leave home, and it was surprising the way in which apparent disabilities disappeared.

The average stay in hospital was ten to fourteen days.

XI. *Bacteriology*.—Cultures were taken in the theatre prior to operation and 75 per cent. of the wounds contained bacteria. Clinical judgment alone was relied upon in selection of cases for suture. Hæmolytic streptococci appeared in no sutured wound.

TABLE V

Total, 135	Negative	34 or 25%
	Positive	101 or 75%
Of 101 positive.....	Staphylococcus	42
	Streptococcus	9
	Gram—Bac.	8
	Gram + Bac.	9
	Anaërobic gas formers.....	7
	Multiple without gas	10
	Multiple with gas	16
		—
	Tetanus Bac.	1

Wounds clinically but not bacteriologically clean did well after suture. Were Carrel's dictum strictly followed out less than 50 per cent. of these cases would have been suturable.

Most of the failures occurred where the Gram-Bac. (pyocyanus) appeared. One failure occurred with a negative culture.

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XII. *Fractures:*

TABLE VI

	S.	T.	F.
Radius	9	0	0
Femur	2	0	0
Radius and ulna	2	0	0
Fibula	1	0	0
Sternum	1	0	0
Tibia and fibula	1	0	0
Spine	1	0	0
Tibia	4	1	0
Scapula	3	1	0
Humerus	4	5	0
Skull	3	0	1
Carpus	1	0	1
Totals—			
S.		32	
P. S.		7	
F.		2	
		—	
		41	

Nearly all these were delayed primary sutures or primary suture. Where the fractures were recognized, hot dressings and appropriate splints were applied, and kept on until time of operation. Femora and humeri were operated upon in the splint where possible.

In this series, at least, the Heitz-Boyer modification of the Leriche technic was followed. The medullary cavity was not touched until all other parts of the wound were thoroughly explored and cleaned up. Then the cavity was curetted for a distance of 1 cm. above the highest crack in the bone after dependent drainage in the bone had been obtained. Usually B.I.P. was rubbed lightly into the raw bone surfaces and a slight streak from the bone to the dependent part of the wound to act as a capillary drain. The wound was then loosely closed, hot dressing applied and splinted. Where impossible to close directly two lateral relaxation incisions were made, the bone closed over and the two wounds of the soft parts treated by delayed primary suture or secondary closure. In this way, the incidence of osteomyelitis was reduced. (Dichloramine-T did not seem to be as useful in this type of wound as in others. It blackened the bone and detached periosteum.) Hot dressings were continued for several days and then replaced by alcohol. These patients were not evacuated so soon as other types.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting, held November 12, 1919

The President, DR. WILLIAM A. DOWNES, in the Chair

RECURRENT INTRAMEDULLARY OSTEOIDCHONDROMA OF FEMUR

DR. DEWITT STETTEN presented a patient thirty-two years of age, who had first come under his care nearly nine and a half years ago. There was no history of syphilis or trauma, but there had been an old apical tuberculosis. For six months he had complained of pain in his left hip and a bad limp. This had begun suddenly and had gradually progressed. He had lost 5 pounds in weight. A tuberculous coxitis in its incipient stage was suspected.

On June 28, 1910, while in the country, he had a slight fall, after which he was unable to walk. He was treated for a fracture of the left femur, possibly complicating a tuberculous focus. He was admitted to the Lenox Hill Hospital July 5, 1910. There was 1.5 cm. shortening of the left leg, but no eversion. Active motion at the hip was impossible. The X-ray showed a rarefied area in the upper extremity of the femur. It involved the great trochanter and extended toward the neck and came down the shaft for a distance of about 10 cm. There was a fissure in the upper surface of the neck and a slight coxa vara. There was no expansion of the cortex. A cyst was suspected and conservative treatment adopted for the time being. A plaster cast was applied for a week and then a Buck's extension for four weeks. A few days after the removal of the extension, the patient, while moving in bed, felt something give way, and had severe pain in the upper part of the thigh. Examination showed a marked outward bowing of the upper part of the femur with 12 cm. shortening. The X-ray showed a decided increase in the degree of rarefaction, still without cortical expansion, though part of the outer cortex had practically disappeared. There was a transverse fracture at the lower pole of the rarefied area. Extension was at once reapplied and operation for what still appeared to be merely a bone cyst decided upon.

The operation was performed on August 25, 1910. Through a longitudinal incision on the outer side of the thigh, the upper part of the shaft of the femur was exposed. The cortex was entirely gone. Instead of entering a cyst, however, a very hard, solid tumor was encountered. This was enucleated subperiosteally without much difficulty. It was

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irregularly lobulated, with an indistinct fibrous capsule, and measured approximately 10 cm. in length, 5 cm. in width, and 5 cm. in thickness. The cavity was thoroughly curetted. Except for a spur of bone, with the lesser trochanter attached, running down from the neck, the upper extremity of the femoral shaft was completely destroyed. The wound was packed, and extension applied.

On section the tumor presents a smooth, hard, homogeneous surface. Microscopic examination shows it to consist mainly of small, irregularly disposed spindle-cells imbedded in a hyalin ground substance. This appears to be undifferentiated osteoid or chondroid tissue. Scattered throughout the growth are islands of true cartilage of varying size. In places these cartilaginous islands are undergoing ossification.

Regeneration was rapid. There was good union in eight weeks. The extension was removed in two months, shortly after which the patient was allowed up with a Thomas splint to guard against refracture. The wound healed in about four months. There was less than 1 cm. shortening, practically no coxa vara, and no eversion. The movements of the hip-joint were perfectly free. Within four and one-half months after operation the patient was walking without crutches. Radiographic examination six months after operation showed marked obliteration of the defect in the bone, even to the beginning replacement of the great trochanter, with practically no deformity. He was then given a course of X-ray treatments. Later radiographs show almost complete restoration of the bone with a preservation of normal contour which reached its maximum perfection in about two and one-half years.

For six years the patient had no trouble with his leg. He gained weight, walked with practically no limp and was apparently well. In September, 1916, he again complained of pain in his left hip and he developed a decided limp. X-ray examination revealed an increased irregularity of the contour of the upper part of the shaft of the femur and great trochanter, with marked mottling of the shadow due to irregular areas of rarefaction. This condition extended into the neck and seemed to extend 2 to 3 cm. further down the shaft than before. A recurrence was suspected and repeated radiographic examinations made. Within two months the areas of rarefaction had become more definite and just below the great trochanter the cortex had been eroded. A decided outward bowing at the lower level of the disease developed. The extension up into the neck and down into the shaft had also increased. The diagnosis of the recurrence was now definitely established and reoperation determined upon.

On November 24, 1916, a second operation was performed. The old scar was excised and the upper end of the femur was exposed. The bone was riddled with tumor tissue of the same consistency as the original tumor. This was imbedded in an irregular bony network. The diseased

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tissue was thoroughly removed piecemeal with a curette. Compared to the easy enucleation of the primary tumor, the difficulty of this procedure was very noticeable. In places the neoplasm had broken through the cortex into the soft parts. The removal of the disease left a defect even greater than after the former operation. The neck and upper part of the shaft were fractured, leaving a small fragment between the fractures. The wound was packed and extension applied.

The microscopic examination of the tumor tissue shows it to be practically the same as the primary growth, except that in places spicules of true bone appear. In the neighborhood of these bony islands the tumor parenchyma merges with the periosteum and osteoblastic tissue, without previous cartilage formation. The tumor cells are here more crowded, suggesting the character of a spindle-celled sarcoma.

The defect gradually filled in. The extension was removed in one month, but several weeks later was reapplied because of outward bowing at the site of the fracture of neck, and inward bowing at the fracture of the shaft, especially the former. In three weeks the extension was again removed. Two months after operation the patient was allowed up, and shortly after that went home, with what appeared to be firm union, particularly at the fracture of the shaft. There was scarcely 1 cm. shortening. Within a week he returned to the hospital with a marked coxa vara, the fracture at the neck having again given way. Extension was immediately reapplied, and the deformity promptly corrected. When the extension was removed after two months more, there was good union and practically no shortening or other deformity. The wound closed in about four months.

The patient remained well until July, 1917, when he slipped and again fractured the neck nearer the head. It was not complete, but it produced the usual coxa vara deformity. Unfortunately, he objected to going back to the hospital and it was not possible to give him satisfactory treatment at his home. He was kept in bed eight weeks with an improvised extension for six weeks, but the deformity was never fully corrected. Union, however, was good, but there was a marked coxa vara with 4.5 cm. shortening. He had no further trouble until January 30, 1918, when he fell again and sustained an irregular transverse fissure through the shaft, just above the point of union between the shaft and the intermediary fragment left after the second operation. He was treated by extension and kept eight weeks on his back. A good callus soon formed, but the shortening was a trifle increased by a slight inward bowing at this point. Since then he has no difficulty. The last X-ray taken in January, 1919, shows a dense bone formation in the upper part of the femur with the remains of the callus at the site of the last fracture. There is a marked coxa vara deformity, but no sign of further recurrence. The patient has a slight limp, but he has no pain and can easily sustain his weight on the



FIG. 1.—August 22, 1910. Radiograph immediately prior to first operation. Note marked increase in the degree of rarefaction, absence of part of the outer cortex, though still without expansion, and transverse fracture at lower pole of rarefied area.



FIG. 2.—March 9, 1913. Radiograph two and one-half years after first operation. Shows almost complete obliteration of defect by replacement with dense bone and preservation of practically the normal contour. There is no evidence of recurrence.



FIG. 3.—November 21, 1916. Radiograph six and one-fourth years after first operation shows marked increase in definiteness and size of areas of rarefaction with further extension up into neck and down shaft. There is extensive erosion of the outer cortex below great trochanter and a decided increase in the outward bowing at the lower pole of the lesion. Diagnosis of recurrence definitely established.



FIG. 4.—April 2, 1917. Radiograph four and one-half months after second operation. The coxa vara deformity, due to re fracture of neck, has been entirely corrected. There is evidence of further callus formation at the site of fracture. Compare with Fig. 10.

FIG. 5.—January 11, 1910. Final radiograph eight and one-half years after first and about two years and two months after second operation. Dense bone replacing operative defects with remains of callus at site of last fracture. Marked coxa vara. No trace of recurrence.



FIG. 6.—Primary tumor.



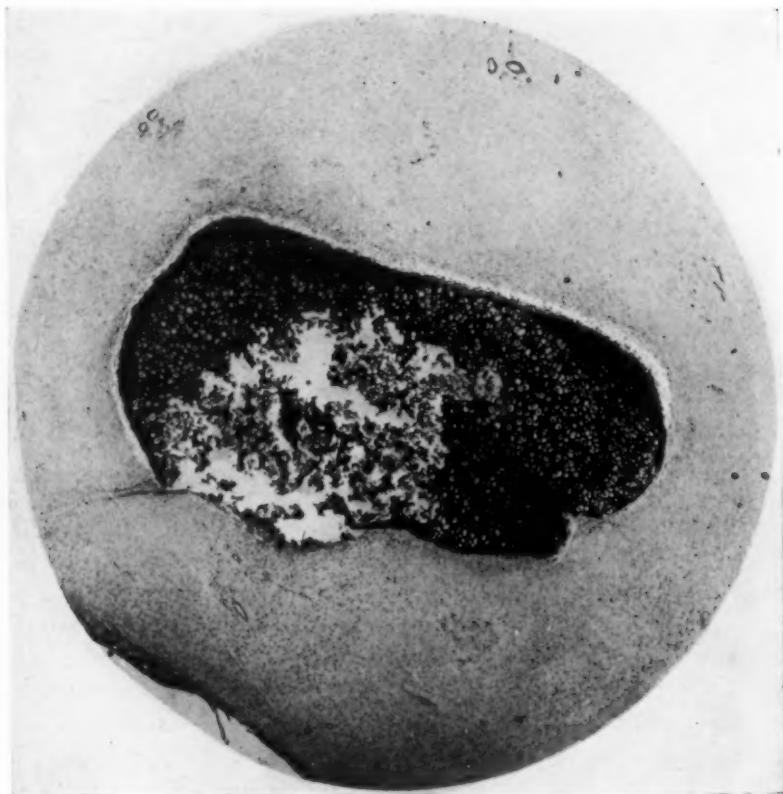


FIG. 7.—Microphotograph from primary tumor. Note cartilaginous island in undifferentiated cellular tissue, with osteogenesis in the cartilage. Magnified 50 diameters.

REFRACTURED FEMUR WITH PLATING

affected leg. There is 5 cm. shortening without eversion. The movements in the hip-joint are practically normal. He has gained 30 pounds in weight and is apparently perfectly well.

According to Bloodgood, these central cartilaginous tumors are extremely rare. In a paper in the *ANNALS OF SURGERY*, August, 1910, he mentions an analogous case of Le Conte's, which he speaks of as unique up to that time. The name *osteoidchondroma* has been applied by Borst to this type of tumor, who classes them among the less benign chondromata.

REFRACTURED FEMUR WITH PLATING

DR. FORBES HAWKES presented a boy sixteen years of age. On August 1, 1914, while playing in the street he had been struck by an automobile and had sustained a fracture of the left femur about its middle. He had been taken to his home where his physician had applied extension in bed for about six weeks. On getting up and around a shortening of about 2 inches had been noticed. His mother insisted that something be done to correct this shortening.

He was brought to the Presbyterian Hospital where he was first seen by Doctor Hawkes on November 1, 1914. A shortening of about 2 inches was found in the left extremity with outward rotation of the limb below the fracture. The X-ray showed a united fracture of the left femur with angulation.

Open operation was performed on November 9, 1914. Solid bony union was found between the angulated and overlapping fragments. The union was broken with chisel and the upper fragment inserted into a V hollowed out in the lower fragment. A vanadium steel plate was attached with screws. During the manipulations a small piece of the lower fragment of the femur had broken off and this was attached to the shaft with a circular piece of wire. A plaster-of-Paris case was applied. The wound healed without suppuration. Measurements showed a scant $\frac{1}{8}$ inch shortening. The callus was very slow in forming and it was not until October, 1915 (eleven months after his operation), that he was able to discard all support with good use of the limb. The knee was stiff from long continued immobilization.

On January 8, 1916, he made a false step while playing out of doors and he felt something "crunch" at the site of the old fracture. He was again taken to the Presbyterian Hospital where two inches of shortening were found and the X-ray showed a refracture through the old area with angulation and the steel plate loosened. Extension was applied for about four weeks in bed with increasing weights, but the shortening could not be reduced to less than $\frac{3}{4}$ inch. It was then decided to remove the loosened plate and to readjust the fractured ends. At the operation on February 3, 1916, no union was found between the upper and lower

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fragments. The small piece of bone which was broken during the first operation was, however, found to be solidly united to the lower fragment. The old plate was removed with the portion of wire, and a smaller vanadium steel plate attached with screws, after the ends of the bone had been brought into good apposition and alignment. He was put up again in a plaster-of-Paris splint. Primary union of the wound was obtained.

On removing the case, March 29, 1916, some outward angulation was found and there was $\frac{1}{2}$ inch shortening. This angulation was rectified by manipulation under gas anaesthesia on March 30, 1916, and Buck's extension applied. The X-ray then taken showed a straighter limb, fair apposition of the fragments, some of the screws loose, and an increase in the amount of callus. This callus was again slow to form and extension was kept up until about November 1, 1916. By January, 1917, he had a good callus and the measurements on both sides were alike. He was gotten up on crutches and by the middle of the summer was getting around on the limb with the help of a cane which he was unwilling to discard. The stiff knee was gradually yielding to baking and massage.

On September 22, 1918, he slipped and fell head over heels down an embankment striking his head and left thigh. He was taken to the Lawrence Hospital first, where they diagnosed a fracture of the left femur, and the next day to the Presbyterian Hospital again. The X-ray there taken showed a transverse fracture of the left femur above the site of the old fractures and just above the insertion of the upper screw of the last plate—with some lateral tilting of the fragments. He was put up in extension for about eight weeks, the weights being gradually increased. Callus formed fairly rapidly and by December 4, 1918, he was up and around on crutches with solid union and no shortening or possibly a scant $\frac{1}{8}$ inch, and 15 degrees of flexion in the left knee. He then gradually got around with a cane and except for the muscular atrophy due to the repeated immobilizations and to diminished flexion of the knee he had good use of the limb.

During the summer of 1919 he had signs of plate irritation and his mother wished the plate removed. The plate and screws were removed on August 29, 1919. Perfectly solid union was found at the site of both fractures. The wound healed by primary union and the boy has good use of the limb at the present time.

DR. HOWARD LILIENTHAL called attention to the disadvantage of leaving Lane's plates in for any length of time, advocating their early removal and stating that for this purpose he employs special screws and the removal of the plates at the end of three weeks, at which time it is possible to accomplish their removal without an anaesthetic and without pain. Healing then proceeds as in an ordinary fracture, sound union being the rule.

CHOLECYSTOGASTROSTOMY FOR COMMON DUCT OBSTRUCTION

CHOLECYSTOGASTROSTOMY FOR COMMON DUCT OBSTRUCTION

DR. WILLIAM A. DOWNES presented a patient, aged fifty-eight, admitted to St. Luke's Hospital July 2, 1918. For past six weeks has had pain in the epigastrium radiating to both right and left sides. This pain came on suddenly, increased by food, relieved by vomiting. For the past five days had constant nausea—unable to retain anything on stomach; vomitus dark in color. One week ago noticed jaundice. Lost 30 pounds in weight since onset of symptoms.

Examination showed a fairly well-nourished man, slightly jaundiced. No masses in abdomen and no tenderness. X-ray examination negative.

Operation (July 8, 1918).—Gall-bladder was distended but contained no stones. No stones in common duct. Pancreas enlarged and stony hard from head to tail. Gall-bladder was freely movable, and easily anastomosed to the anterior surface of the stomach. Stab wound drain in the right flank—wound closed. Convalescence uneventful. Discharged August 7, 1918. Patient has continued to gain in health and is free from all symptoms at the present time.

A second case, aged forty-eight years, was admitted to the Medical Service, St. Luke's Hospital, August 6, 1919. Two months before admission patient began to feel weak and lost his appetite. Five weeks ago had an attack of vomiting. Three similar attacks subsequently. Has had no pain or feeling of discomfort in the epigastrium. Two weeks before admission to hospital had a chill and this was followed by jaundice. Soon noticed that bowel movements were clay-colored.

Examination showed well-marked jaundice, otherwise negative except for slight tenderness in gall-bladder region. Under medical treatment jaundice gradually disappeared and patient was discharged on August 30 with a diagnosis of catarrhal jaundice, possibly cholelithiasis.

Readmitted October 3, 1919, with marked jaundice and with a history of having had repeated chills during the past two or three weeks. Temperature on admission, 104°. Slight tenderness in region of gall-bladder, but no definite mass could be made out. Patient had lost 30 pounds since the onset of symptoms. Probable diagnosis was common duct stone, possibly neoplasm.

Operation (August 6, 1919).—Cholecystostomy. Gall-bladder was found to be moderately distended and common duct also distended. Exploration of gall-bladder and duct showed no stones. Head of pancreas was enlarged, hard, and seemed to be the seat of a new growth. Gall-bladder was easily sutured to anterior wall of the stomach. Culture from gall-bladder showed colon bacillus. Wound closed without drainage. Convalescence uneventful. Discharged November 5, 1919. Jaundice rapidly disappearing, patient is gaining and is relieved of all symptoms.

DR. HOWARD LILIENTHAL inquired why Doctor Downes chose the

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stomach for his anastomosis. He had performed the operation of cholecystenterostomy in suspected carcinoma of the pancreas. He also was not willing to grant from the presentation of the second case that the patient was not suffering from carcinoma of the pancreas.

DR. EDWIN BEER considered these cases very instructive and interesting. He stated that as Doctor Downes had intimated, there was a tendency in obstructive jaundice where no stones are found, but where there is more or less induration and tumefaction of the head of the pancreas, to close the abdomen without a side-tracking operation. He considers this practice a vicious one because in such cases, at times, excellent results can be obtained by side tracking the flow of bile either into the stomach or intestine. With regard to the reported cases he considers no one can say definitely whether they were malignant or not. In undoubtedly malignant cases where there is a palpable nodular tumor in the head of the pancreas, it is good practice to side track if the patient's condition will allow it; there is also another type of case, chronic obstructive jaundice with benign tumors of the papillæ which are likely to be confusing as no palpable mass is discovered, and result fatally because no side tracking operation is performed. After having seen just such cases at autopsy and unoperated in Vienna, Doctor Beer concluded that such cases should be given the benefit of the doubt, an attempt being made to side track. Whether this side-tracking operation should be a cholecystogastrostomy or a cholecystenterostomy is a debatable point. Statistics have shown that anastomosis with gut may lead to inflammation of the gall-bladder and to multiple hepatic abscesses, while the sterile condition of the stomach favors the biliary passages. (Kehr had only one infection of the bile passages in sixty cholecystogastrostomies.)

DR. LUCIUS W. HOTCHKISS thought that the cases presented showed the advisability of doing an anastomosis rather than mere drainage. He stated that he had had one experience some years ago with drainage where the sinus persisted for a long time, the patient finally leaving the hospital well; the patient later returned when a cholecystogastrostomy was done and the patient had remained well.

DR. FREDERIC KAMMERER said that when the gall-bladder was automatically in such a position that it could be utilized for purposes of anastomosis, some palliative operation should always be done in these desperate cases. He was fully aware of the fact that cachectic patients, suffering from malignant obstruction, did not stand surgical interference well, even if only an exploratory incision had been done. But a few of his cases, where evidently a mistaken diagnosis of malignant tumor at the head of the pancreas had been made, had done very well after a cholecystenterostomy and had been observed for several years without infection occurring in the biliary tract.

DR. CHARLES L. GIBSON endorsed the position taken by Doctor Downes

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regarding the advisability of providing internal rather than external drainage in this type of case. He believed it impossible to tell in many instances whether one is dealing with a malignant or benign condition. He never has had occasion to utilize the stomach in anastomosis in such cases. Doctor Gibson stated that he brought up this subject in a paper read before this Society eighteen years ago, and that he was now ready to offer a contribution in the later history of a patient regarding the possibility of infection in anastomosing the gall-bladder to the small intestine, and a very definite proof of cure of chronic pancreatitis by proper internal drainage. The patient referred to was operated on while in a state of chronic jaundice under the diagnosis of carcinoma of the pancreas. An anastomosis was made between the small intestine and the gall-bladder, a section of the pancreas being removed for examination; the report upon this specimen was chronic interstitial pancreatitis. The woman got perfectly well, enjoying better health than ever before. Seven years after this operation she had a loose kidney operated upon, at which time Doctor Gibson took the opportunity to feel of the pancreas and found that it was normal. He considered this a cure both anatomically and physiologically. This patient has been under observation for ten years and in good health with absence of infection as the result of drainage to the intestine from the biliary passages. Doctor Gibson also stated that recently he had had occasion to make an anastomosis between the hepatic duct and the small intestine, a full report of which case he would present at a later date.

DR. ALEXIS V. MOSCHOWITZ said that in the presence of so much unstinted praise for the operation of cholecystostomy and cholecystenterostomy he hesitated to express his own opinions upon the subject; he felt compelled to do so, however, because in his experience the operation in cases of carcinoma of the pancreas had been unqualifiedly bad. In his opinion, even the performance of an exploratory operation frequently shortened the life of the patient, and he hesitated to operate whenever the history and physical examination leave no doubt as to this diagnosis.

DR. WILLY MEYER believes one should attempt to ascertain whether he is dealing with a benign chronic pancreatitis or with a malignant tumor, but acknowledged that this was not always easy. At the same time, he said that if the patient had not lost much weight, and if in the presence of a chronic jaundice the patient states that he never had any colic, an examination of the head of the pancreas will usually locate the seat of the trouble. If this is very much localized, hard but not nodular, he believes one will not go far wrong in assuming the condition to be benign rather than malignant. He recalled a few cases of chronic pancreatitis in which he simply drained the gall-bladder to the surface for a prolonged period, and the patients were cured. In reference to malignant

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infiltration of the pancreas anastomosis is, of course, the operation of choice. When using the first portion of the jejunum as in gastroenterostomy, or a longer portion and turning it over as in anterior gastroenterostomy, he has not seen infection of the bile-ducts. Still, it must be better for the patient to make the anastomosis further up, *viz.*, connect the gall-bladder with stomach or duodenum.

Doctor Meyer said that too much stress could not be laid upon the benefit of the repeated subcutaneous injection of large doses of human blood serum two to three days prior to operation, stating that even in cases of true cholæmia the results of this method have been surprising in obviating secondary hemorrhage.

DR. ELLSWORTH ELIOT said that for many years he had been interested in the treatment of simple benign stricture of the hepatic or common duct, or both. With regard to the anastomosis he stated that as a matter of fact the nearer the entrance of the common duct into the intestine the anastomosis is made the less likely is the development of subsequent ascending suppurative cholangitis. If an anastomosis at a distance from the mouth of the common duct is essential he considers an anastomosis above preferable to one below that level. Although he could not cite many cases of long standing from his own experience, yet from the experience of others he could recall several in which the end result was satisfactory in at least four and in one instance six years after operation following anastomosis between the stomach and the duct. Given a dilatation of the gall-bladder with dilatation of the common duct, the choice of the site of anastomosis is a difficult one to make. In all cases of stricture with mild dilatation of the gall-duct, only anastomosis between the dilated duct and the alimentary canal gives a more satisfactory result than between the gall-bladder and alimentary canal, the reason being that the biliary pressure within the duct, although normally low, is a more efficient barrier against the entrance of germs than is the negative pressure within the gall-bladder.

DR. WILLIAM A. DOWNES, in closing, stated that he used the stomach for the anastomosis because of the greater ease with which it is reached. He has had no experience with infection and he is inclined to believe that Doctor Beer's remarks were based on cases in which the anastomosis has been low, jejunal or colic, rather than to the stomach or duodenum. So far as Doctor Lilienthal's remarks are concerned, Doctor Downes was inclined to believe his first case not to be malignant because he is under the impression that cancer of the pancreas is a rapidly fatal disease. According to Doctor Erdman's statement, it is a question of months, not years.

GAUCHER'S SPLEEN

DR. HOWARD LILIENTHAL presented a patient, forty-one years old, who had entered the service of Dr. Morris Manges at Mt. Sinai Hospital sev-

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eral months before her transfer to the surgical service, to which she was admitted on May 22, 1916.

Her father had died of tuberculosis. She had been operated upon for abdominal abscess seven years before at the Presbyterian Hospital. She had last menstruated nine years before admission.

For thirty-four years she had noted a left-sided abdominal mass slowly increasing in size. For a year there had been pain in the right hypochondrium together with some precordial pain with cough and mucoid expectoration. During this year there had been occasional night sweats and fever, and for ten years there had been occasional blood-stained sputum. For four months pain and discoloration of the lower extremities. An enlarged lymph-node in the left axilla had been removed, and on examination a structure suggestive of Gaucher's disease had been noted.

The blood showed a total cholesterin of .0875 per cent. The patient complained bitterly of pain in the bones of her lower extremities and some pain in the arms. It was because of this symptom that she applied for treatment.

When first seen the operative risk did not seem very favorable. She was a small emaciated woman with an enormous mass, evidently the spleen, occupying three-quarters of the abdomen; the liver had dropped so that the right lobe was in the upper portion of the pelvis. There was clubbing of the fingers, pigmentation spots on the skin, and petechiae of the conjunctivæ. The urine contained a trace of albumin and a few white blood-cells. Hæmoglobin, 45 per cent.; red blood-cells, 2,000,000; white blood-cells, 1200; polymorphonuclears, 48 per cent.; lymphocytes, 42 per cent.; large mononuclears, 8 per cent.; eosinophiles, 2 per cent.

On May 29, 1916, she was operated. The blood-pressure was 175 systolic. Both thighs were now ligated close to the body so as to segregate the blood and the pressure rapidly fell to 155 when it was noted that the pressure of the cuff on the arm had caused the appearance of petechiae in the forearm. Examining the thighs petechiae were also discovered here. In spite of this ominous sign, the patient was anæsthetized by Doctor Branower with ether by the open method and with the assistance of Dr. Martin Ware the operation proceeded.

Incision from ensiform almost to the pubes through the left rectus muscle and this incision was continued along the border of the ribs to the flank. The lower portion of the spleen was now easily turned out and the hilum exposed. The large calcareous splenic artery was ligated and also a vessel which was thought to be the splenic vein; the hand inserted up to the diaphragm disclosed as much of the spleen as that which occupied the abdomen below. An enormous splenic vein was now found and in trying to encircle it with the aneurism needle it was perforated. The exposure was so perfect, however, that there was no

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trouble in securing the vessel again. The lienorenal ligament was clamped in sections and the spleen cut away. A very large amount of blood came from the ablated spleen, spurting from it in a thick stream fully five or six inches away from the organ. All the arteries in the abdomen were apparently much sclerosed and calcified. The liver was of a peculiar yellow color and was greatly prolapsed, having been evidently dragged down by the spleen. The ligatures were then removed from the thighs and a small intravenous saline infusion given.

The wound was closed without drainage. Six hours after operation the patient's pulse was 132, but of a thready quality, although her general condition did not appear to be bad. However, 400 c.c. of blood were transfused by the direct method of Unger. In dressing the wound a heavy pad of non-absorbent cotton was placed over the abdomen so as to take the place of the removed organ. It was a case of Gaucher's disease. The patient made a good recovery and was discharged July 4, 1916, much improved.

A study of this case made by Dr. F. S. Mandlebaum, Director of Laboratories, Mount Sinai, will be found in the *American Journal of the Medical Sciences* of March, 1919. He reported the weight of this spleen directly after removal as 4250 grammes (nine pounds six ounces), but it must be remembered that probably two pounds of blood escaped from the spleen after it had been cut away from its attachment.

The patient is alive and active.

DR. WILLIAM A. DOWNES said that in 1913 he had operated upon a case of Gaucher spleen which was later included in Mandlebaum's series. The patient was a woman, twenty-eight years of age, with conjunctival changes and pigmentation and other symptoms indicative of the typical text-book picture of Gaucher spleen, although the proper diagnosis was not made. At the present time, seven years later, the patient is in good health following operation.

TREATMENT OF INFECTED WOUND OF THE FOREARM

DR. H. M. LYLE presented a man who on October 14, 1919, had been gored by a bull. The horn passed through the skin of the right forearm and came out in the cubital fossa, two jagged wounds resulting. The lower wound was 2 by 4½ inches and ran obliquely upward and outward across the forearm. The upper wound, 2½ by 7 inches, passed in a spiral manner around three-fourths of the circumference of the arm, following in a general direction the crease of the elbow. The wounds were sewn up. Forty-eight hours later he was admitted to St. Luke's Hospital with a badly infected forearm. The wounds were opened and a so-called Carrel-Dakin treatment begun. Smears from the wound showed innumerable bacteria. Cultures showed staphylococcus albus, streptococcus,

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and colon bacilli. Up to the 22d of October (seven days) little progress was made. On this date a strict Carrel-Dakin technic was instituted. Four days later there was less than one bacterium in the field. On the eighth day the wound was sutured.

He wished to demonstrate through showing this case what could be done by the strict adherence to Carrel technic and remarked that he had the good fortune to be in charge of one of the earliest ambulances which used the Carrel-Dakin method in its entirety, and that he had been able to follow the method for four years. In the hands of men who thoroughly understood the method it could be employed like an instrument of precision, and definite results prognosticated, and that on his return from France he had had an opportunity of going through one of our large military hospitals. A so-called Carrel-Dakin technic was being employed. One month later he went through the same hospital and had the pleasure of seeing a correct technic by a man who understood the methods. The results were as different as day from night. In other words, if you are going to treat wounds by the Carrel method, do it, but do not employ an imperfect technic and call it the Carrel method.

Regarding those who throw cold water on this method, he thought he could not do better than quote from Dr. John Gibon's article, "Advancement in the Treatment of Wounds and Infections Resulting from the War" (*Am. Jour. Med. Sci.*, clvii, 764): "The Carrel-Dakin treatment of infected wounds is one of the big things surgery has gained by the war; and the man who says there is nothing in it, that it is too cumbersome, or that there are a number of other methods just as good, has either never seen a hospital where the treatment was being properly used, or else he is so hide-bound that his opinion is worthless."

DR. CHARLES L. GIBSON in discussing this case begged that if a surgeon applies anyone's name to a method he is using, he follows the exact direction of the originator of the method, in which connection he cited various instances where it was stated that the Carrel-Dakin method was employed in the treatment of a case, but where in reality nothing like the method was used. Even in the hospital where he had personally instituted the accurate Carrel-Dakin method it was not being carefully followed, but all sorts of modifications were being made, and then discrediting of the method resulted.

AN ANALYSIS OF THE RESULTS OF SIX YEARS' FOLLOW-UP SYSTEM IN A SURGICAL SERVICE

DR. CHARLES L. GIBSON read a paper with the above title, for which see p. 661, vol. Ixx.

DR. JOHN H. BRANNAN (by invitation) expressed his interest in the financial side of the follow-up system, stating that it was his desire to have a well-equipped and properly maintained bureau at the Bellevue

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and Allied Hospitals, but that the expense of such a plan would not be carried entirely by the city. In the discussion of Doctor Gibson's paper he expressed the opinion that the author made out his results worse than they really were, because he tells of all the deaths of which he has report, but does not take into consideration the results in those cases which he has been unable to follow.

DR. ROBERT T. MORRIS stated that in his opinion in order to present scientific testimony in relation to hospital work it was necessary to develop elaborate and expensive systems, entailing not only work but special experience, a new responsibility for a new public. An enlargement of hospital facilities is also needed to the extent of caring for the patient whom we follow up. He seldom has proper after-care. A patient with tuberculosis is not cured after securing surgical relief; he requires treatment for tuberculosis in general. This must be maintained over a long period of time, including adaptation of climate, food, work, treatment by tuberculin, etc. The same criticism is made in cases of pyosalpinx: many chronic gonococcus infections are amenable to treatment with vaccine, although some cases are not. In cases of ulcer of the stomach or duodenum the patient, having received surgical treatment, has received only first aid in his case; following this first aid it must be discovered what stands behind the ulcer. That means a proper medical examination of the sources of infection and the patient's whole economy. Therefore, more and more one is impressed by the fact that the follow-up system has merely opened up a larger vista of needs than the public ever has seen before, and the next step is to impress the public with this fact.

It is Doctor Morris' belief that the bad results in chronic appendicitis are due to the fact that appendicitis is so often spoken of as a diagnostic entity when it is so often really only a part of a whole representing in the irritated regions fibroid degeneration, lymphoid changes, which are presented to view; for this reason he considers that operations for chronic appendicitis are bound to be unsatisfactory unless better diagnostic work is done in advance of operation. A chronic appendicitis is only a part of a whole case in so many instances.

DR. GEORGE WOOLSEY said that at Bellevue Hospital on the second division the follow-up system has been in existence for four years, and that in order to discuss some of the points in the paper before the Society he had looked up their own statistics, especially in relation to ulcer of the stomach and duodenum. He was impressed by the fact that one's prognostic ideas are often overthrown by the statistics developed. Some of these patients reporting three months after their operation will be recorded as in excellent condition; the same patients returning at the end of nine or twelve months may have some complaint and will be graded as showing only satisfactory or perhaps even unsatisfactory results; or the reverse may obtain; the reading of the statistics, therefore, depends partly upon the question of the time of their return.

RESULTS OF FOLLOW-UP SYSTEM

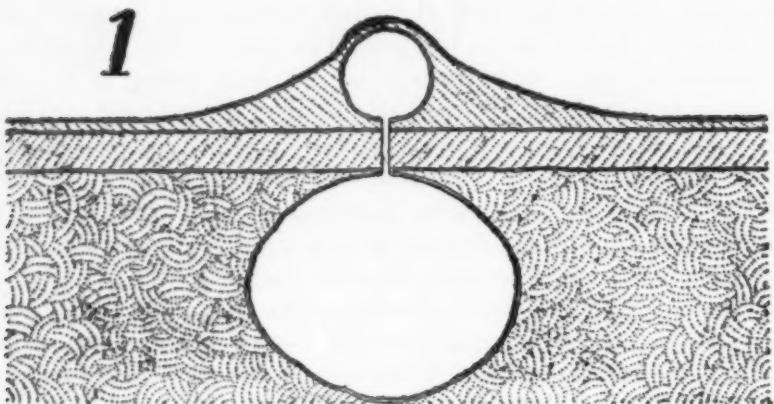
In considering the question of pyloric occlusion in duodenal ulcer, Doctor Woolsey stated that he had tried it in some twenty odd cases, and then made up his mind that it was of no use, only adding to the operation, and he has therefore not used this method for the past two years; he was surprised, however, in looking up these cases to find that the results in this group, where pyloric occlusion had been done, were the best of any in duodenal ulcer; the grading of excellent and satisfactory together amounted to 94.4 per cent. Another group of gastric ulcer cases where he expected more satisfactory results was that in which transverse or meso-gastric resection was done. In this group the primary results were excellent, but the ultimate results were not so satisfactory. He considered these cases disappointing. With regard to chronic appendicitis he considered it of interest to note that a number of cases of gastric or duodenal ulcer had had their appendices removed without relieving the symptoms, the primary trouble not being in the appendix; the same point is illustrated in the systematic removal of the appendix in cases of gastric or duodenal ulcer, where a large number show pathological changes. With reference to the perforating ulcers he had had only one case, operated on at the Hudson Street Hospital, no gastroenterostomy being done, in which, on later admission to Bellevue, a second operation was found necessary for recurrence.

DR. ALEXIS V. MOSCHCOWITZ considered the paper by Doctor Gibson one of the most valuable contributions ever read before the Society. He had made notes of a number of points which he wished to discuss, but owing to the lateness of the hour he would confine himself to that of chronic appendicitis, which, according to Doctor Gibson's statistics, showed, in about 30 per cent. of the cases, a failure as far as a permanent cure is concerned.

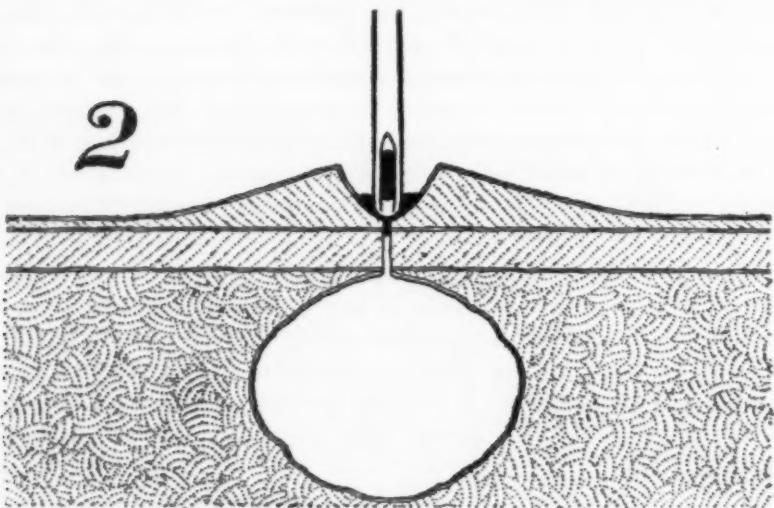
Cases of chronic appendicitis so-called had interested him for a number of years, and finally he arrived at the conclusion that from a viewpoint of prognosis all cases of appendicitis may be divided into only three classes. (1) Cases of appendicitis, or those in which the appendix always shows distinct evidence of disease; these, with the exception of those that died, get well, and more than that, they never have any trouble subsequently. (2) Cases which show very little pathologic change; some of these get well, and then they belong in the first group; some do not get well, and then they belong in group three. (3) Cases which show no evidence of disease, and never get well. They are the bane of the careless diagnostician, and of the surgeon who operates upon too slight an indication.

DR. CHARLES L. GIBSON, in closing, answered Doctor Brannan's question as to the financial side of carrying on such a system by stating that, with the exception of a very small and recent contribution, all of the work had been done at his own expense, and that he considered this the only satisfactory way of undertaking such a task.

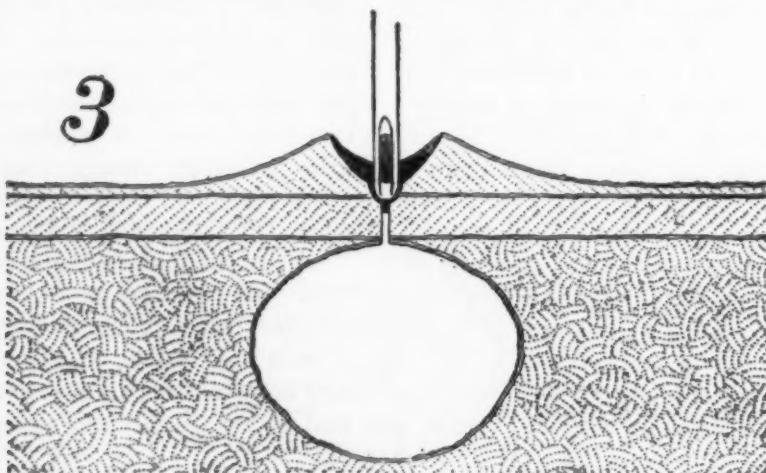
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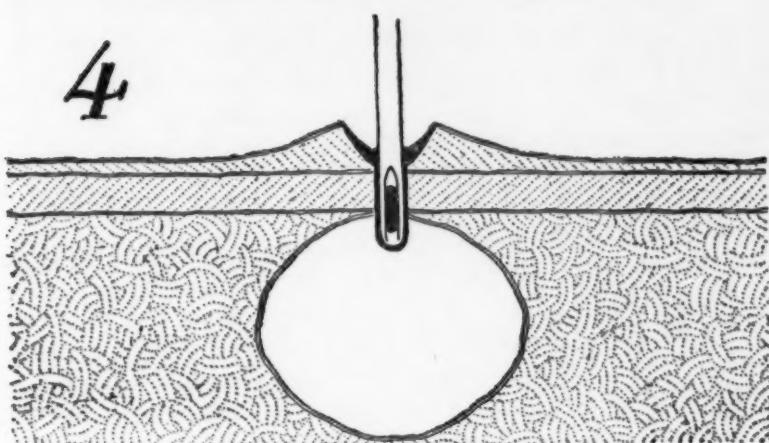


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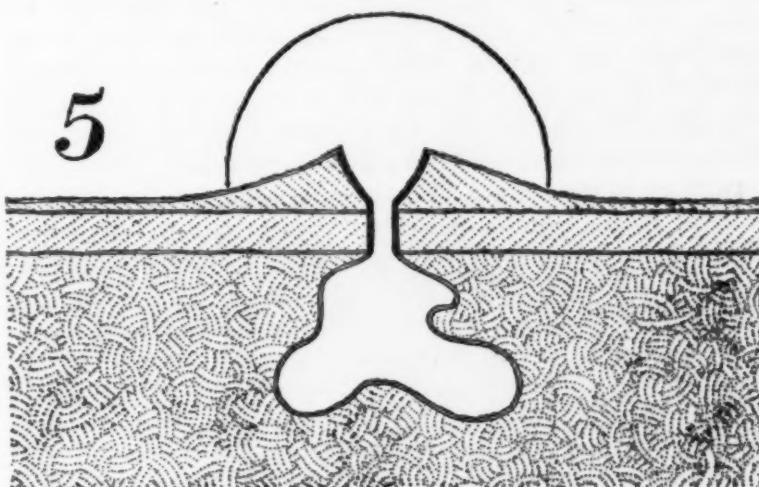


AN ORIGINAL METHOD OF TREATING BOILS

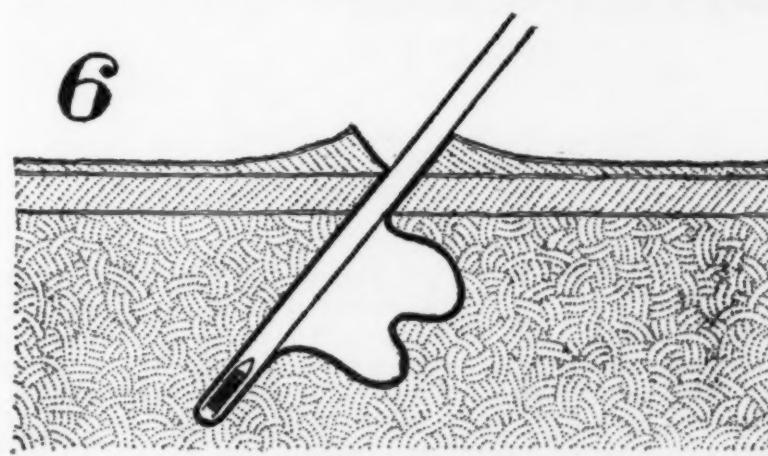
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AN ORIGINAL METHOD OF TREATING BOILS

DR. THEODORE DUNHAM presented a method which had the advantage of avoiding cutting, involving little or no pain, and as a result is followed by little or no scar; it utilizes 95 per cent. carbolic acid in a very simple way, availing itself of three properties of this agent, namely, its anæsthetic property, its cauterant property, and its antiseptic property.

First take the head off of the furuncle and evacuate the pus on the surface, wiping out the little cavity that remains. Take the eye of a surgical needle and plunge it into the 95 per cent. carbolic acid, then begin to work at the bottom of the crater; after working at that for a little while a point of less resistance will be felt and that is the point where the little pore exists through which the infection crept down into the cellular tissue. By redipping the needle in the carbolic and working about this area one very readily anæsthetizes the tissues; this should not be done too quickly, a little time being allowed for anæsthesia, when the progress of the needle through the cutis vera is attended with no pain. Before long one will feel that the needle plunges into a cavity, in other words, it has gone through the cutis vera, and when this is accomplished one withdraws the needle and makes a little pressure. If there is pus in the cavity it will swell up to the surface. The next procedure is to reintroduce the needle, after dipping into carbolic, into the cavity and rather gradually allow anæsthesia to take place, reintroducing the needle several times; then sweep it about until the whole surface of the pus sac has been cauterized with the acid. When this has been thoroughly done some little blood serum will exude, indicating that the wall has been quite thoroughly cauterized. Very often on the following day it is found necessary to reintroduce the needle and recauterize the sac; sometimes this may even be necessary on the third day, but usually by this time all pain has disappeared and a little scab has formed, when there is nothing further to expect except absorption.

Stated meeting, held November 26, 1919

The President, DR. WILLIAM A. DOWNES, in the Chair

BANTI'S DISEASE—THIRD STAGE

DR. EDWIN BEER presented a patient twenty-seven years of age who had been admitted to the medical service of Doctor Libmann at Mt. Sinai Hospital in 1916; his chief complaint was vomiting of blood, pains in the upper abdomen, and black stools. On examination he was found to have muddy complexion, enlarged liver and spleen, with a systolic murmur at apex; his haemoglobin was 33 per cent.; red blood cells, 2,592,000; leucopenia with 6400 white blood cells, of which 71 per cent. were polymorphonuclears; 7 per cent. large lymphocytes; 20 per cent. small lymphocytes; 1



FIG. 1.—Shows large shadow in left lumbar region opposite lower border of third lumbar vertebra.



FIG. 2.—Shows X-ray catheter passed up left ureter and pyelogram of left kidney. The shadow in previous plate is well mesial to left ureter.

FIG. 3.

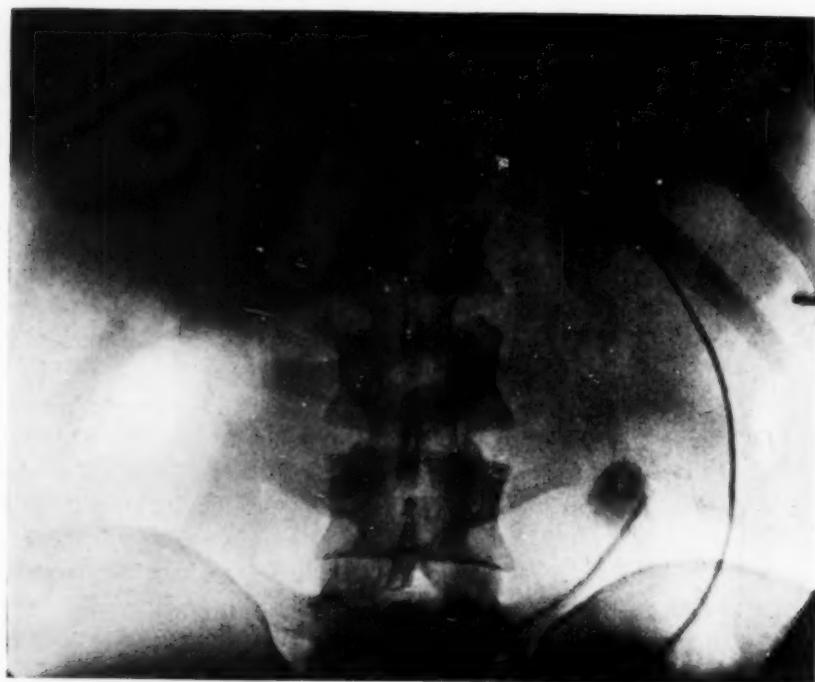
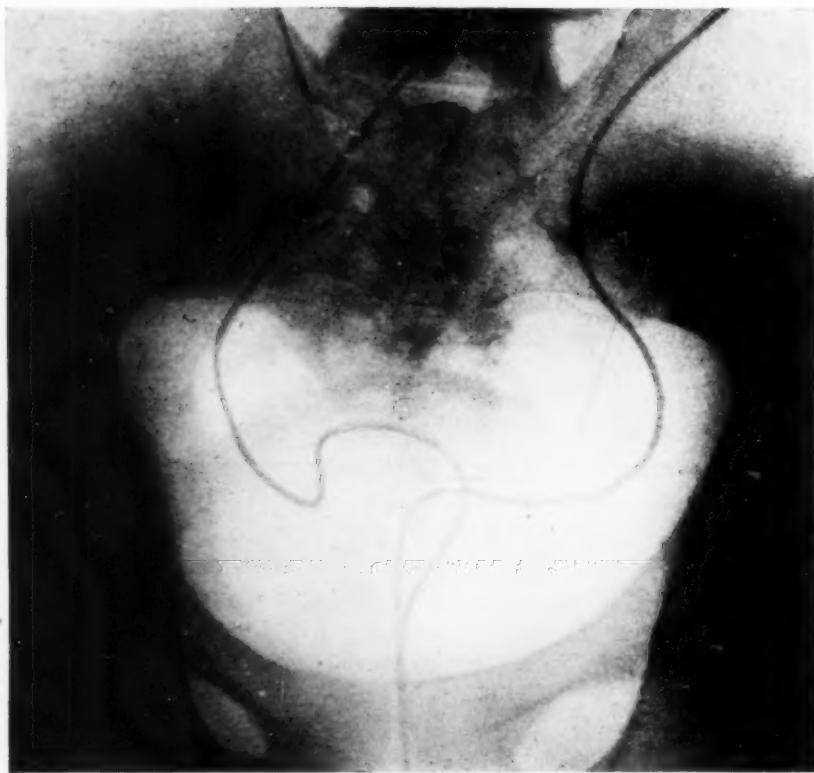


FIG. 4.



FIGS. 3 AND 4.—X-ray showing catheter passing up right and left ureters and the right ureter evidently crossing the median line and reaching the stone shadow placed in the lower pelvis of the fused kidney.

ANTERIOR PYELOLITHOTOMY FOR STONE IN FUSED KIDNEY

per cent. eosinophiles; 1 per cent. transitioanls; 1 normoblast. On observation he had tarry stools, his spleen was 15 cm. long, extending from the sixth interspace to 2 cm. below the ribs, there was distinct ascites, and the liver was percussed from the fourth space to the free border. Wassermann test and urinalysis were negative. Subsequent blood counts showed a slight leucocytosis, at one time reaching 24,000. In other words, on the medical service the patient presented a picture of a large spleen, varying leucopænia and leucocytosis, ascites, and tarry stools, upon which a diagnosis of Banti's disease in the third stage was made.

On the 26th of October, 1916, Doctor Beer performed a splenectomy. At this time the abdomen was full of fluid, the spleen was four times its normal size, and there were omental adhesions to the parietes; the liver was hobnailed as in cirrhosis, and the splenic vessels were sclerotic. Splenectomy was fairly simple, the incision being L-shaped. After two and one-half weeks' sojourn on the surgical service the patient was returned to the medical side, although at that time he was running a temperature of 100°: the temperature gradually rose and a subphrenic pyopneumothorax diagnosed. Again transferred to the surgical service, through a low incision the last rib was resected and the subphrenic pyopneumothorax opened by Doctor Beer. The wound closed rapidly, but six months later, in the scar from drainage of the chest there developed an abscess, through which the patient discharged a ligature which had been applied to the splenic vessels.

Up to the present time the patient has gained 40 pounds, now feels perfectly well, and a blood count made on November 12, 1919, by Doctor Gross showed red blood cells, 4,080,000; white blood cells, 7400; haemoglobin, 78 per cent.; the differential showing, 44 per cent. polynuclears, 55 per cent. lymphocytes, no transitioanls, and 1 per cent. eosinophiles.

ANTERIOR PYELOLITHOTOMY FOR STONE IN FUSED KIDNEY

DR. EDWIN BEER presented a patient who had been admitted to Mt. Sinai Hospital on April 18, 1919. He complained that for the last two years he had had pain to the left and below the umbilicus, in the left lumbar region, radiating to the spine and umbilicus. He also had haematuria at times. His physical examination was completely negative except for the abdominal condition. A few white cells and occasional red cells were found in the urine. To the left of the umbilicus and following in a measure the left iliac fossa, was a distinct mass, only slightly tender, and which had the consistency of kidney tissue. He apparently presented a typical picture of a left kidney stone in a low kidney; X-rays very distinctly showed a concretion to the left and below the umbilicus the size of a cherry close to the crest of the ilium in the left lumbar region (Fig. 1). The patient was cystoscoped with the result that his bladder

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and ureteral orifices were found absolutely normal; an X-ray catheter was then passed up the left ureter with the object of proving that the stone was in the mass felt on palpation, but contrary to expectations, the catheter passed several inches outside the mass, the pylorogram showing a very normal pelvis (Fig. 2). Catheterized specimens from the ureters showed that the right ureter delivered no indigo-carmine, while the left secreted it very well; urea was 1.5 on both sides; there were some white blood cells obtained from the right ureter but none from the left. It was then deemed advisable to pass X-ray catheters into both ureters, and in the left the catheter passed up to a normal but highly situated pelvis; in the right ureter the catheter crossed the spine and passed up to the stone in the left kidney (Figs. 3 and 4). Upon this result Doctor Beer diagnosed a fused left kidney with no kidney on the right side. At operation on May 5, 1919, the kidney was readily exposed, and through an anterior incision into the pelvis of this lower part of the kidney the stone was encountered and easily removed, the pelvis being sutured without leakage. The patient made an uneventful recovery, and except for a transitory attack of pyelitis six months ago has remained perfectly well.

During the operation, on examining the kidney, Doctor Beer could feel the vessels arising from the left common iliac and running into the lower pole of the fused kidney, and at the place where the lower part of the kidney was fused with the normal left kidney there was a distinct narrowing or bridge formation three-fourths the size of a normal kidney. The ureter from the upper pelvis ran anterior to the lower part of the fused kidney.

Doctor Beer considers the use of X-ray catheters extremely important in such a case, as without them there is always the possibility of realizing too late that there is not a second kidney upon which to depend if nephrectomy is the operation performed.

EXCISION OF THE THYROID GLAND SINUS

DR. EDWIN BEER presented a patient particularly to produce discussion upon the best technic to be followed in such cases. He stated that this patient developed three and a half years ago an acute swelling in the middle of the neck from which a sinus opened and drained. Seventeen months ago on admission to another hospital he was operated upon, the sinus apparently being excised. Four months later the sinus recurred and another operation was performed. On admission to Mt. Sinai Hospital on May 1, 1919, a third operation became necessary and at this time through a transverse incision the sinus, after being injected with methylene blue which proved valueless, was removed. Using a probe of heavy silkworm gut Doctor Beer was able to follow the sinus up to the body of the hybrid bone, and then having excised the sinus up to this point and

EXCISION OF THE THYROGLOSSAL DUCT SINUS

not finding any hole in the body of the hyoid bone, as in other cases, he excised the body of the hyoid bone and all fascia and connective tissue between the muscles above the hyoid bone in the median line up to the floor of the mouth without searching for an extension of the sinus. This wound was closed and a counter incision furnished drainage. The patient was re-examined in October, 1919, and no evidence of further trouble discovered.

DR. JOHN F. ERDMANN said that in regard to the excision of thyroglossal duct sinuses he considered these cases among the very hardest in which to obtain good results, as usually up to the present time it was more a question of luck than technic, nearly all cases undergoing multiple operations before someone happened to obliterate the sinus. Only a week ago he had operated for the third time upon a physician's sister, although at each previous operation he had been convinced he had reached the seat of the trouble. He now believes Doctor Beer's suggestion to take out the body of the hyoid bone, dissecting the muscles and fascia up to this point, as an excellent procedure, and when his former patient again presents herself for operation, which he considers more than likely, he will adopt this method.

DR. A. S. TAYLOR said that it had been his fortune to see quite a number of these cases in Doctor Weir's practice, and that he had a few in his own. Doctor Weir had also found methylene blue unsatisfactory, for in dealing with a closed pocket, as in these cases, unless the needle reaches to the top of the sinus the blue fails to reach also and is ineffectual as a guide. He had seen some cases where the sinus ran through the hyoid bone and some in which it ran back of the bone. He advises making an incision in the median line above the hyoid bone, thus coming down on the tract, then eliminating the sinus above the hyoid bone to the base of the tongue, making a wide excision, when it becomes a simple matter to get the whole thing out; he then advises the use of a fine probe for the purpose of scraping the sinus in the bone, and so removing its epithelium and preventing further secretion.

DOCTOR BEER, in closing, said that it was surprising that a condition in which operation has so often proven unsatisfactory has never had a satisfactory technic worked out, for there must be some one method applicable to these cases. He had a small series of such cases following the technic which he recommends in his report as follows:

Inject the sinus with methylene blue (although rarely satisfactory), follow up to the hyoid bone on a probe of silkworm gut, making a wide excision of the sinus, resecting the hyoid body, follow up in the median line between the geniohyoid and geniohyoglossus muscles, taking even portions of the muscles and all the connective tissue and fat in the median line well up to the floor of the mouth. By this method he has obtained his best results.

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SKIN GRAFTING

DOCTOR HOGUET stated that ordinarily there was more or less luck regarding skin-grafting, but he considered the method he had employed in these and other cases to be uniformly good in its results. This method was taught at the War Demonstration Hospital and is a modification of the Staige Davis method. The skin is taken up by a straight Hagedorn needle held in an artery clamp, the needle being flamed between each introduction under the skin, and a small amount of skin, varying in depth from the whole thickness of the skin to one-half its thickness, used for the grafts. The success of this method depends upon three essential factors; first, there must be an absolutely sterile surface upon which to place the grafts, and the best way to obtain this is to use the real Carrel method; second, the type and adjustment of the dressing for absolute immobilization of the grafts is essential. He advises the use of paraffine mesh gauze such as is obtainable from the Abbott Chemical Company, placed directly on the grafts covered with compresses soaked in Dakin's solution; these compresses are removed daily and resoaked, but the mesh gauze is not removed for about a week, when the grafts will be found to be firmly attached. Also on the surfaces from which the grafts are obtained a silver foil dressing is used.

The first patient, a middle-aged woman, while working in a hospital laundry had a portion of the laundry machine drop on her arm, producing two large wounds. Doctor Hoguet, happening to be in the hospital at the time, did a primary suture immediately, but the skin of both wounds sloughed. After Dakinizing one wound could be sewed up but the other surface was so large that the edges of the wound could not be approximated, therefore grafts were taken from the thigh and were not placed very close together. At present there is a very good result, every graft having taken.

The second case was that of a man who had a large necrosis of the skin from erysipelas. He was operated on at the French Hospital by Doctor Keyes on June 3, 1919; the grafts were placed close together. Of 107 grafts taken from the left thigh only 4 did not take.

The third patient had a large cavernous angioma extending from the occiput forward, for which he was operated in March, 1919. This growth had increased so in size that for a year the large oedematous mass hung over his eye and involved a certain amount of the eyelid. On removal of the tumor it was found impossible to bring the skin edges together, and therefore 171 inch grafts were put on the pericranium and one large thin Thiersch graft was placed over the eyelid in order to make a new eyelid. A silkworm gut suture running across the wound was held responsible for moving some of the original grafts; therefore, sixteen days later 50 more grafts were made. Of these 221 grafts all took. Even

SKIN GRAFTING

though a difficult procedure his dressing for both head and eye was paraffine mesh gauze, and in addition over his eye were kept wipes soaked in salt solution, while the dressing over the head was saturated with Dakin's solution.

Doctor Hoguet then presented a recently operated patient in order to show the appearance of these pinch grafts about a week after operation.

DR. NATHAN W. GREEN asked that Doctor Hoguet state definitely how deeply he cut the skin for the grafts, and for how long a period he found it necessary to allow the paraffine gauze to remain.

DR. C. A. McWILLIAMS inquired what advantage these pinch grafts had over the larger Thiersch grafts of which fewer would be necessary to cover the areas. It was his opinion that Thiersch grafts took just as readily as the smaller pinch grafts. Doctor Hoguet had inferred that there was much greater doubt of the Thiersch graft taking than the pinch grafts. Why is there this difference in the taking of the two grafts? An advantage of the Thiersch grafts is that the treating of them is much quicker than the pinch grafts, because the cells of the latter grafts require time to spread out over the granulating surfaces between the grafts.

DR. JOHN F. ERDMANN believed Thiersch grafts to be more useful than pinch grafts, and advocated the use of the Krause-Wolf method in grafts of considerable size. He also stated that he had not used Dakin's solution on skin grafts, although he had frequently performed this operation, and he believed that if the field were cleansed without Dakin's, a Thiersch graft transplant, covered with saline solution and gauze, keeping it moist for a week without redressing, the results would be perfectly satisfactory.

DR. J. P. HOGUET, in closing, answered Doctor Green's query that the depth of the grafts varied because in using a Hagedorn needle with which to obtain them it would depend upon how deeply the needle was inserted into the skin as to the thickness of the graft. As to the time that it was usually necessary to allow the paraffine mesh to remain on, this averaged about eight to nine days before the first redressing.

In reference to Doctor McWilliam's remarks, Doctor Hoguet said that previous to sterilization with Dakin's solution he had never had any success with large grafts, no matter what method of dressing was used, but that he advocated the pinch grafts because they were so much more successful. He presented the present method because it was applicable for the use of local anaesthesia and because such a large percentage of the grafts always took. He modified the original method by the placing of his pinch grafts somewhat nearer together; also he found that where the patient is not his own donor for the graft it was necessary to find a donor with a non-antagonistic blood type in order to get the graft to take readily.

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CHOLECYSTECTOMY AFTER CHOLECYSTOSTOMY

DOCTOR HOGUET presented a patient who had been operated upon two years ago for cholelithiasis, a cholecystostomy being performed, from which she recovered. Returning to Doctor Hoguet about three weeks ago she said that she had been suffering for the past six months from the identical symptoms which she had formerly. Operation November 12, 1919, showed a moderately enlarged gall-bladder surrounded by a tremendous number of adhesions, going up on the surface of the liver, down on the right side from the ascending colon and duodenum and then on the anterior face of the stomach; cholecystectomy was done and on opening the gall-bladder a pocket in the upper portion was found as a result of the previous operation—the gall-bladder was distinctly pathological, having a red, hyperæmic, somewhat thickened wall with three or four small gall-stones. The interesting point was the closing of the upper portion of the gall-bladder by the infolding of the wall at the previous operation. The specimen of gall-bladder was exhibited.

CHRONIC APPENDICITIS

DR. A. S. TAYLOR presented this case as being representative of the large percentage of so-called chronic appendicitis cases in which removal of the appendix has been followed by increased troubles rather than relief. Also, it suggests that attributing gastric disturbances to reflex influences from the appendix should be countenanced only after the essential disturbances of the stomach itself have been properly eliminated from consideration.

The patient, a young woman, twenty-two years old. Up to 1913 she was ordinarily in good health. At that time she began to suffer from periodic sick headaches, which gradually became more frequent and disabling. After two years, in 1915, her physician decided that she was suffering from chronic appendicitis with reflex disturbances of the stomach.

Therefore, the appendix was removed. The scar is only about two inches long, so that no abdominal exploration could have been done at that time. The removal of the appendix gave no relief to her sick headaches, but in addition to her previous troubles, there was a steady dull pain in the right abdomen. This pain seemed to have no relation to the taking of food. She was not troubled with gas formation or constipation. She had not lost weight. The pain from which she suffered was made worse by standing, was somewhat relieved by sitting in a crouching position, and by lying on her stomach. An abdominal belt has given some comfort, but no real relief. Her attacks of headache and accompanying vomiting have lately become more frequent and so severe as to interfere seriously with her work.

Physical examination shows her to be a woman of small size, well nourished and of fairly good color, though somewhat sallow.

CHRONIC APPENDICITIS

The scar of her appendix operation is located at the outer edge of the right rectus muscle and is about two inches long. There is marked tenderness about this scar. At the outer edge of the right rectus, at about the level of the eighth costal cartilage is a small area of marked tenderness to pressure. There is no excess of gas in the abdomen, nor anything else to be made out in the examination. Doctor Goodridge stated that examination of the stomach contents, stools and urine showed nothing abnormal.

A gastro-intestinal X-ray series showed high fixation of the duodenum, showed marked gastrophtosis and coloptosis. There was persistent unevenness of the duodenal cap and well-marked elongation of the first part of the duodenum when the patient is in the erect posture. Otherwise the series showed nothing abnormal.

Diagnosis of duodenal fixation by peritoneal fold was made because of the type of pain, the lack of essential digestive disturbance or constipation, the influence of the posture on the pain and the appearance of the pictures.

Operation was done July 24, 1917. A transverse rectus incision was made just above the navel. When the peritoneum was opened the liver presented in the wound and was normal. When the liver was elevated the duodenum was found to be held fast to the gall-bladder and the cystic duct by a firm fold of peritoneum which ran forward half way to the fundus of the gall-bladder, and was continuous with the edge of the lesser omentum. This double layer of peritoneum was divided with the scissors with practically no resulting hemorrhage. The duodenum, at the junction of the first and second parts, was held tight up against the cystic duct and the under surface of the quadrate lobe.

Before dividing the membrane it could not be budged at all by manipulation. After the membrane was divided, including the edges to the true lesser omentum, a moderate amount of pull downward on the duodenum mobilized it sufficiently for it to form an easy natural curve from the stomach outlet in place of the sharply angulated position it had previously maintained.

Its mobilization downward amounted to nearly 7 cm. The raw surface exposed by dividing the membrane was covered in by whip-stitching the peritoneal edges of the gall-bladder and the lesser omentum with fine catgut.

Further investigation showed very firm adhesion of the omentum to the upper end of the appendix scar. This adhesion was about the size of a quill and ran from the hepatic flexure, a distance of about 5 cm., to the scar. It was divided between double ligatures.

No Jackson's membrane was present. The stomach showed no intrinsic abnormalities beyond a moderate dilation. The wound was closed without drainage, and she was returned to bed in good condition.

Her post-operative course was uneventful. The sutures were removed

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on the tenth day and there was solid primary union. She sat up on the eighteenth day and returned home on the twenty-first day.

Since that time she has improved steadily in general health and capacity for work. She has had none of her previous headaches with the exception of one which occurred while she was still in the hospital and which was the result of smuggled sweets. She is now practically perfectly well.

DR. J. F. ERDMANN said that the description of the membrane in this case would lead him to believe that it was like that described by Harris, of Chicago, in the *Journal of the American Medical Association* some seven years ago—anterior mesogastric membrane producing symptoms of duodenal ulcer.

DR. EDWIN BEER thought that as Doctor Taylor was presenting this case in connection with the paper by Doctor Gibson at the last meeting, he would take this opportunity to say that he was surprised that no one had asked Doctor Gibson at that time how the diagnosis of chronic appendicitis was arrived at in his case, because if the diagnosis is a mistake in the beginning no one can hope to cure such a condition by appendectomy. It is his opinion that the diagnosis of chronic appendicitis is one of the most difficult to make. In this connection he referred to a case seen by him and Doctor McWilliams having all the symptoms of kidney stone. But X-rays and the filling test of the pelvis as well as most careful kidney tests proved negative; then on filling the intestine by Bastedo's test acute pain was produced over the appendix. Doctor Beer had therefore removed the appendix, but about six weeks later the patient, reporting to Doctor McWilliams, asked why they had not removed the right kidney stone which later showed very clearly in X-rays taken at the Presbyterian Hospital. Doctor Beer believed that many of the so-called failures to cure chronic appendicitis were due to a mistake in the diagnosis.

DR. CHARLES A. ELSBERG stated that in many cases where the appendix had been removed for supposed chronic appendicitis, and the symptoms persisted, he had been able to prove the diagnosis to be wrong; in seven such cases he had to remove spinal cord tumors which had been the cause of the symptoms.

DR. WILLIAM A. DOWNES said that in this connection he had read not only Harris' description but also one by Ochsner who some years before had called attention to a similar type of band. He felt that if he knew he was going to encounter such a membrane in any case he would prefer to send the case to Doctor Taylor, as he had tried to separate such bands in various cases, but had never felt satisfied that he had relieved the patients. Speaking of operation for so-called chronic appendicitis he

FASCIA TRANSPLANT FOR RECURRENT VENTRAL HERNIA

reported a mistake in his service at St. Luke's Hospital, where in the case of an English soldier the diagnosis of chronic appendicitis was followed by appendectomy; in answer to a letter from the "follow-up" it was found that the man had been operated upon in Brooklyn a few months later and a large gall-stone removed.

DOCTOR TAYLOR, in closing, said that his attention had first been called to this condition by Doctor Harris' paper, and that for some time he had believed it to have been brought to light by Harris, but later found that several men, both in America and abroad, had already described more or less the same condition. In many of the cases reported the patient was said to have had an operation for chronic appendicitis previously; one or two had had previous operations for gall-stones. Of course, where one is dealing with post-operative adhesions, together with a congenital membrane, the results, as a rule, are not so satisfactory.

FASCIA TRANSPLANT FOR RECURRENT VENTRAL HERNIA

DR. HAROLD NEUHOF presented a patient, forty-eight years old, operated upon for gall-stones in 1916, and admitted to Mt. Sinai Hospital in the fall of 1918 with a post-operative ventral hernia. This was repaired under general anaesthesia. Many omental adhesions were found and divided. Peritoneum and aponeurosis were freed, peritoneum was sutured, and the aponeurosis was overlapped with stout chromic sutures. After operation a severe pneumonia set in. About one month after operation the patient noticed the return of bulging of the scar and recurrence of symptoms. The bulging was progressive and could not be retained by a supporting belt.

Readmitted to the service of Doctor Lilienthal at Mt. Sinai Hospital in July of this year, complaining of pain in and bulging of scar of previous operation and frequent cramp-like epigastric pains without vomiting. There was a long incision in the right hypochondrium presenting a large hernial defect that increased with coughing or straining. Physical examination of the chest disclosed an advanced emphysema with hyperresonant percussion, diminished breathing, and sibilant and sonorous râles throughout.

From the experiences encountered after the previous operation as well as the physical signs in the chest, it was determined that local anaesthesia only could be employed with safety to the patient. The defect in the aponeurosis was exposed and after its edges were freshened was found to measure 5 inches in length and $2\frac{1}{2}$ inches in diameter. Its shape was irregularly oval with the widest portion above. One side of the gap

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being close to the free costal margin, mobilization of this portion was impossible, and it was evident that even with wide mobilization of the mesial margin approximation could only be obtained by suturing under tension. Accordingly a fascial transplant for the defect seemed the simplest and best procedure in this case. The transplant was removed from the lower portion of the iliotibial band where the structure is thickest and strongest. It measured 5 by $2\frac{1}{2}$ inches and was exactly the size and shape of the defect. It was fixed in place at 4 points with fine chromic sutures and interrupted sutures were placed between these points. The skin was closed over the transplant.

Primary union took place except at the lower angle of the wound where there was a serous discharge for a time and exposure of the lower-most portion of the transplant. This subsequently healed over by granulation. It is now four months since operation. The patient is free from symptoms. The transplant can still be felt as a firm plaque made prominent by having the patient bend backwards. The persistence of this plaque-like alteration of the transplant for many months after operation has been noted in other cases. The abdominal wall is not on the whole of good tone, but there is no evidence of recurrence of the hernia. There is no hernia or other abnormality at the site of removal of the transplant from the thigh.

DR. WILLIAM A. DOWNES inquired if Doctor Neuhof was able, as a general rule in such cases, to separate the skin and peritoneum and thus to preserve the peritoneum intact. He had found it difficult to do in many cases and wanted to know if Doctor Neuhof would advise placing the graft directly over the omentum and intestines when the peritoneum was lacking?

DOCTOR NEUHOF, in closing, answered Doctor Downes' question by stating that he had not opened the peritoneum in this case, because at the previous operation it had been opened and many adhesions found, and he therefore did not consider it necessary to do more than repair the defect in the aponeurosis, and by making an incision to one side of the scar the cicatricial tissue could be readily excised. He believed that the peritoneal endothelium would grow over the inner surface of the transplant just as it does elsewhere over defects, in those cases in which it was necessary to implant fascia across a gap in the peritoneum.

CENTRAL LUXATION OF THE FEMUR

DR. NATHAN W. GREEN reported a case seen by him at the City Hospital in 1914 of a man who had fallen from a third-story window, his fall

CENTRAL LUXATION OF THE FEMUR

being intercepted by a signboard. He struck on his left hip and sustained a severe injury; he could move his hip but with pain. The X-ray showed a broken acetabulum and the head of the femur pushed in. The patient was seventy-one years of age, of melancholy habit, and on pushing up the window he fell out. While in the hospital he was a little out of his head and could not be put in a cast nor could he be adequately immobilized because of his many bruises and the low vitality of his skin. He was therefore placed on a water-bed with practically free motion of his limb. He left the hospital in June, 1914, and had not been seen by him since that time. Doctor Green, however, obtained the report from his daughter that after being home a week he was taken to a hospital for the insane where he lived for about three and a half years, and that during that time he had walked without a limp. He had had no appliance or reduction of his injury, having been allowed constant motion.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held November 3, 1919

The President, DR. GEORGE C. ROSS, in the Chair

BONE TRANSPLANTATION FOR OLD UNUNITED FRACTURE

DR. A. B. GILL presented L. T., a girl ten years of age, from South Carolina, admitted to the Orthopaedic Hospital June 5, 1917. The brief history that was sent with her stated that she had a fracture of both bones of the leg above the ankle at the time of birth, that the fractures had never united, and that the patient had never walked on her foot but had always gone on crutches. Examination showed an ununited fracture of both bones of the leg above the ankle (Fig. 1). The foot could be placed in apposition with the leg in any direction. There is a shortening of four inches.

June 18, 1917: First operation. The tibia was exposed and an inlay bone graft from the same tibia was placed to span the fracture. The graft was taken from the upper fragment of the tibia, and was turned around so that the upper portion of the graft was embedded in the internal malleolus. This was done in order that the normal bone from the upper portion of the tibia should bridge the gap between the fragments (Fig. 2).

The leg was dressed in plaster for twelve weeks. On October 8, 1917, the case was removed. It was found (Fig. 3) that the graft was broken at the site of the fracture. A second case was applied for another month at the end of which time non-union was still present (Fig. 4).

November 16, 1917: Second operation. On exposure of the tibia it was found that the first graft had healed in, but had not been large enough; therefore, at the second operation another bone inlay of the entire width of the tibia was placed in a manner similar to that employed at the first operation.

Three months later it was found that no union had occurred. Radiograph examination showed a complete absorption of the graft and thinning of the tibia with an absorption of the lime salts. Patient was fed on bone marrow and had daily treatment by baking and massage to increase the nutrition of the leg.

April 12, 1918: Third operation. Tibia was exposed and tunnel drilled in the head of the tibia, and a second one in the inner malleolus. The surface of the shaft of the tibia of both fragments was planed off with osteotome, so that there might be fresh bleeding bone the entire length of the tibia. A large transplant was then

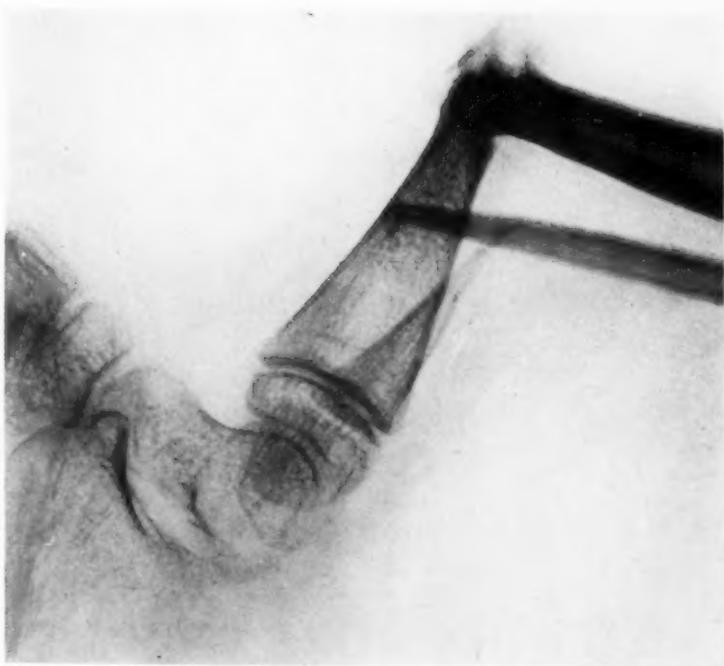


FIG. 1.—Before operation.

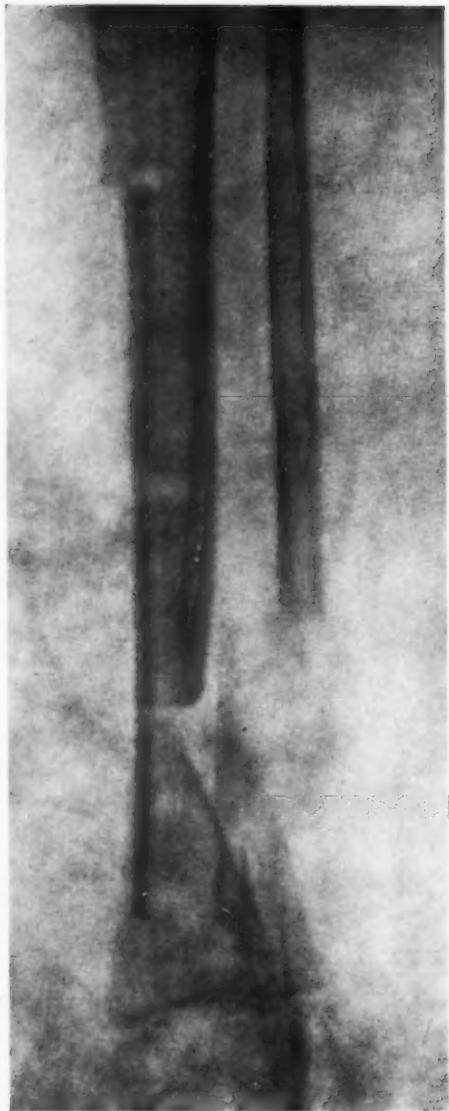


FIG. 2.—Transplant bridging gap between the fragments.

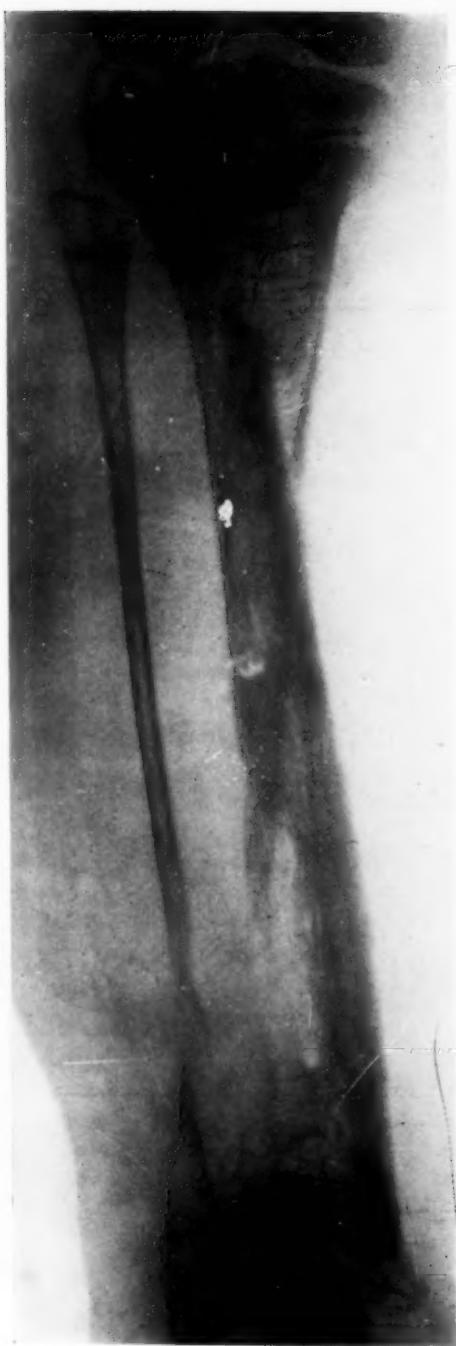


FIG. 3.—Showing fracture of the transplant.

FIG. 4.—Showing non-union still present.



FIG. 5.—Five months after third operation, showing union between transplant and fragments, and growth of transplant.





SPRENGEL'S DEFORMITY

taken from the other tibia. Its ends were buried in the tunnels already prepared, and the medullary surface was held in contact with the shaft of the tibia by means of catgut ligatures. The leg was dressed in plaster. A new case was applied on the first of June. It was found that fairly firm union was present. A high shoe was fitted to the case and the patient permitted to walk and bear her weight on the case. When the second case was removed six weeks later firm union was present. The patient was fitted with a brace and a high shoe. September 25, 1918, patient was discharged. She had good union (Fig. 5) and she was walking well by means of the brace and the high shoe.

This case is of interest because it demonstrates that union may be secured in an ununited fracture after a lapse of almost any number of years, and second, because it shows the futility of using too small a transplant. This patient would have been saved two operations if a large transplant had been taken from the other tibia at the first operation. This child has a shortening of four inches in her extremity which can never be made up. This shortening is due to the lack of development of the extremity because she did not bear weight on it. Had union with the fracture been secured earlier she would not have so much of a deformity and would not be so severely handicapped.

SPRENGEL'S DEFORMITY (CONGENITAL ELEVATION OF THE SCAPULA)

DR. A. B. GILL also showed R. T., a girl three years of age, who was born with a congenital elevation of the scapula. There is no history of similar deformity elsewhere in the family.

Examination on admission: The left scapula is elevated about $1\frac{1}{2}$ inches with only $\frac{1}{4}$ inch motion up and down, and with but slight motion on rotation. The upper angle lies in the posterior cervical region $1\frac{1}{4}$ inches below the mastoid process. The upper angle and the upper margin are distinctly hooked forward. The posterior margin has a marked angulation at its centre and forms an angle at this point of almost 90 degrees. From this point of angulation a distinct firm band can be felt extending to the sixth cervical vertebra. The scapula rotates about this angle where the band is attached. The child is unable to elevate her arm above her head, nor can the arm be placed in this position passively. The hand cannot be placed behind the neck.

At operation October 8, 1919: A curved incision about three inches in length was made just behind the posterior border of the left scapula with the lower end of the incision slightly below the middle of the scapula. Skin and fascia were divided. A plate of bone was found extending from the point of angulation at the middle of the posterior border of the scapula obliquely upward to the sixth cervical vertebra. The scapula in the region of this posterior angulation was cartilaginous. The angle of the scapula was excised with the plate of bone attached. A distinct articulation occurred at this

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point. It was then found that the bony plate could be moved freely through an articulation with the spine. It was detached from the vertebra.

The scapula could not be brought down to a normal position. The trapezius muscle was separated from the posterior portion of the spine and the two rhomboids and the levator anguli scapulae were also detached from the scapula. It was found that the supraspinatus was made tense on attempting to move the scapula downward. It was therefore loosened from its posterior attachment. The angle and the upper portion of the scapula as far as the suprascapular notch was found to be sharply hooked forward. This portion of the scapula was excised. The scapula could then be brought down into almost normal position and there seemed to be no tendency for it to return. Wound closed. Child was put to bed on a Bradford frame with the left hand fastened to the upper part of the bed to maintain the arm in extreme abduction, and to rotate the scapula and hold the posterior border down.

November 3, 1919: Wound is healed, and the scapula is in almost normal position, the lower angle being but very slightly above the lower angle of the opposite scapula. The child's arm can be held above her head, and placed behind her neck. There is free rotation and up and down motion of the scapula. Daily active and passive exercises must now be given in order to develop and maintain free motion of the scapula and the upper extremity.

DR. J. TORRANCE RUGH presented three specimens from cases of Sprengel's deformity upon which he had operated and all of which had the same characteristics as shown in Doctor Gill's case. He had operated on four cases in twenty-seven years. Three had had the extra piece of bone running in from the top or from the side of the spinous process, usually of the seventh cervical vertebra, and attached to the posterior superior angle or the posterior border of the scapula. The most recent one had been done that morning in a child three years of age in the Methodist Hospital. The long bony process coming from the side of the spine of the cervical vertebra or from the side of the lamina (the posterior aspect) extended down along the posterior border of the scapula. It was attached to the scapula about one inch above the lower angle; that is, it was on the ventral side of the scapula. The scapula was deformed much as the one Doctor Gill has shown, there being no posterior superior angle. It was necessary in this case, because of hooking over of the posterior border of the scapula, to separate all muscular attachments and then cut off the upper border of the scapula. After this it was easy to draw the scapula well down over the chest wall.

The specimen shows a large piece of bone running from the spine down to the scapula and shows a reversion to one of the primitive types of the lower animals. There have been a number of operations advised for correction of this deformity, but each case must be cared for in

TREATMENT OF NON-UNION IN COMPOUND FRACTURES

accordance with the conditions present. Recently, one operator advised cutting a V-shaped piece up into the body of the trapezius muscle and drawing the scapula down. That would be absolutely useless in a case such as Doctor Gill's, because the attachment or elevation is not due to shortening of the trapezius muscle, but due to the attachment between this bony growth and the scapula.

DOCTOR GILL, in closing, stated that he detached the trapezius from the posterior portion of the spinous process of the scapula and did not notice whether there was any accessory process of the muscle or not. He did not dissect out the muscle as he wanted to do as little injury to the parts as possible.

The etiology of this deformity as mentioned by Doctor Rugh is interesting. It is known that the upper extremity develops in the cervical region, and during foetal life descends to the position which it occupies at birth. In Sprengel's deformity there has been an arrest of the normal descent of the upper extremity. The cause of its failure to descend is not absolutely clear, but in cases such as the one shown to-night it is possible that the presence of the suprascapular bone will account for it.

TREATMENT OF NON-UNION IN COMPOUND FRACTURES

DR. DE FOREST P. WILLARD read a paper with the above title, for which see page 182.

DR. JOHN H. JOPSON said that non-union in gunshot fractures is, like suppuration, one of the reproaches of military surgery. We have learned much as to its prevention in the course of the war. The principles of prevention are much the same as hold true in the case of the industrial injuries of civilian life, and the knowledge we have gained is especially applicable to this class of cases. Whereas in the early years of the war widespread excisions were done in the continuity of bones, the site of gunshot fractures, with a relatively large percentage of cases of non-union, it was soon clearly demonstrated that the solution of continuity of the periosteum in these cases was seldom complete, and the old principle of removal of totally detached splinters and the preservation of those only partially separated was, when combined with careful cleansing in the course of débridement, followed by much superior results in the way of prevention of non-union. Satisfactory healing at the same time could be obtained. The introduction in modified form by Leriche of the old Ollier technic, by which a subperiosteal resection was performed of such portions of bone as required removal in the course of débridement, raising with the detached periosteum a thin layer of bone cells, was of distinct value in certain classes of cases in which the fracturing missile had penetrated or perforated the bone, carrying with it, in the case of missiles of low velocity, an infection which may or may not have been present with missiles of other types. In fractures involving the joints we also found it of advantage. With Leriche's special form

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of elevator this was a simple matter. In gunshot fractures, as in compound fractures of other types, the introduction of metallic plates is fraught with risks that constitute contraindications to its adoption as a safe and acceptable procedure. In a few cases of oblique fracture, as Blake has shown, a Parham band, or in a smaller bone a silver wire, can be placed around the bone ends as a temporary splint, with the expectation of removing it later. In the latter case it may "heal in" even when the superficial wound is not closed. Compound fractures of large bones were, of course, left open until demonstrated sterilized sufficiently for suture, and treated in the meantime by the Carrel-Dakin technic. Efficient traction and fixation are the factors, in addition to the proper operative handling of the wound, in the prevention of non-union. The employment of skeletal traction has been amply demonstrated to be of great value in this connection. We used it in the form of the tongs, with much satisfaction. Where there has been a considerable loss of substance the tongs must be retained in use for a correspondingly longer time, to avoid buckling of the bone at the site of excision, which we have seen occur following their early removal. The after treatment includes the care of the muscles and the preservation of the function of neighboring joints. In the treatment of non-union itself, the bone graft, judiciously used, is, as Doctor Willard has emphasized, the most generally accepted, and apparently the ideal form of treatment. Bad results have occurred by its too early use as well as by its indiscriminate application in the hands of partly trained surgeons. Another and simpler form of fixation, the results of which were very satisfactory in the hands of Doctor Graves of the orthopaedic services, was in the use of kangaroo tendon for fixation in operations for non-union. Two sutures were used, the bone ends each being drilled in two places, at right angles to each other, and the sutures being knotted in the same fashion. Satisfactory fixation was thus obtained even in the femur. Has Doctor Willard had any special experience with this method?

DR. W. HERSEY THOMAS stated that he favored the Chutro graft but that at the time of treating these cases he was using intramedullary aperiosteal grafts. In one particular instance a tibial transplant had been placed in a radius to bridge a 6 cm. defect following a gunshot wound. The case did well and one month later was transferred to another general hospital where his splint was inadvertently removed almost immediately after his arrival. When next seen, two weeks later, the graft had slipped out of the lower fragment and the condition was that shown upon the plate. In a second operation (twelve weeks after the first), the upper end of the graft was so firmly incorporated with the proximal fragment that it was difficult to tell the original graft from the proximal fragment itself. The lower end of the graft was brought back to its original bed in the distal fragment but fractured while it was being laced in position with kangaroo tendon. A second graft was then taken

ABSCESS OF THE PROSTATE

from the tibia and one end fixed in the distal fragment. The other end of the graft was laced to the original graft which had become incorporated in the proximal fragment. It is now three months since the second operation. The man has good union and can pronate and supinate.

The next case was that of an intramedullary bone-graft for a gunshot fracture of the upper third of the humerus. This man's wound had been healed for over a year and he had had a long course of massage and physiotherapy. Shortly after the operation the wound became infected with a haemolytic streptococcus. The wound was laid open at once and Carrel-Dakin treatment instituted. Despite the infection and open treatment, this patient speedily gained a firm union and a good strong arm. Several sinuses remained for a few months, but he has now been solidly healed for six months and is enjoying the most active use of his upper extremity.

DOCTOR WILLARD, in closing, said that regarding the use of the kangaroo tendon in the femur cases, he had seen the cases of Doctor Graves at the Aberdeen Hospital in Scotland and they seemed to be healing remarkably firmly. He had treated a case of malunion in which refracture of the femur was done in which the fragments were held by that method. The forearm fractures were put in plaster of Paris, with a window for six or eight weeks. The cast was then cut in two, leaving a plaster-of-Paris mould; then began the treatment of light massage on the forearm, light motion to the fingers was started immediately and further motion as soon as possible. The mould is kept on so long as the X-ray shows there is need of it, perhaps for four months. In a femur case in which the operation was done in October, the cast was not taken off until December. Yet distinct bowing in that femur occurred. In another case the cast was kept on for at least four months.

ABSCESS OF THE PROSTATE

DR. ALEXANDER RANDALL read a paper with the above title, for which see page 172.

DR. D. B. PFEIFFER stated that it had always seemed strange to him that prostatic abscess was not more frequent than is the case. That when one examines the prostate microscopically as he had done several years ago in many cases, one is impressed with the number and narrow calibre of the glands that ramify deeply within the stroma of the prostate. Often the signs of chronic inflammation with cellular infiltrate are found, but it is seldom that the cellular deposit is within the lumen of the glands and the polymorphonuclear leucocyte is much less common than the round cell. In other words, the microscopical evidences of acute inflammation and pus formation are usually lacking. This corresponds with the relative infrequency of abscess as observed clinically, while chronic inflammation and indeed acute inflammation without abscess are commonly found. It would seem that the muscular stroma

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possesses in common with muscular structures elsewhere in the body special facility in dealing with infective processes whether by rapid absorption or by its ability to keep the ducts open by intermittent contraction.

In view of the relatively uncommon character of the condition, this series reported by Doctor Randall is in reality an extensive experience. He had recently seen a report of 30 cases of prostatic abscess by two French observers which were the number encountered in 10,000 consecutive cases of genito-urinary conditions. The conclusions reached by a study of this series approximate very closely those stated in the paper we have just heard. The majority of the cases were very closely related to antecedent venereal disease, but instrumentation did not play any marked rôle in exciting the attack. The striking feature of these cases is the severity of the local and general symptoms, and there can be no difference of opinion as to the necessity of early incision and drainage.

DR. LEON HERMAN said that he was interested in the small proportion of cases of prostatic abscess in Doctor Randall's series due to specific cause. Undoubtedly, the majority of such abscesses originate as complications of gonorrhœal urethritis. He could not agree in all respects with Doctor Randall's viewpoint regarding the treatment of these cases. The mere suspicion of pus was not in his judgment sufficient justification for perineal incision. In the absence of systemic symptoms sufficient to warrant the diagnosis of the presence of pus, he believed the great majority of these cases should be treated palliatively.

If the local examination reveals the presence of abscess, however, these cases should be operated upon regardless of the absence of systemic reaction. Acute retention of urine occurring during the course of acute posterior gonorrhœal urethritis is usually considered pathognomonic of prostatic abscesses, but to this rule there are important exceptions. One case occurred which necessitated catheterization for a period of three weeks. There was in this instance an enlarged and tender prostate, but the local findings were not characteristic and the systemic symptoms were very slight. This individual recovered without operation and he felt sure that rupture of an abscess into the urethra did not occur.

Periurethral or periprostatic abscesses can be drained perineally only after traversing an approximately normal prostate gland to reach them; a procedure of doubtful propriety. True prostatic abscesses should, of course, be operated upon without delay. There is, however, little justification in my judgment for operation in cases where the symptomatology and physical findings are indefinite and inconclusive.

He agreed thoroughly with Doctor Randall that these abscesses should be drained perineally where the necessity for evacuating them arises. The majority of them can be ruptured intra-urethrally by the passage of a sound and at least 65 per cent. will rupture into the urethra spontaneously. Not only in chronic disease the aftermath of this sup-

ABSCESS OF THE PROSTATE

posedly happy termination of the abscess but the danger of rupture into the other areas is too great to justify procrastination.

He had recently seen at the Pennsylvania Hospital a patient with a urinary fistula of the left inguinal canal. The left testicle had been removed for tuberculosis epididymitis, following which he developed an abscess of the prostate. This ruptured spontaneously both into the prostatic urethra and through the abdominal wall with the formation of a urethro-abdominal fistula.

Prostatic abscesses of gonorrhœal origin have been known to terminate in this same manner.

DOCTOR RANDALL, in closing, said that he felt that these cases should be operated and operated early. The important element was to save the patient from urethral rupture. It is almost a daily experience to see cystoscopically the after results of bad prostatic infections with the picture of deep sinuses leading down into the prostatic gland. Conditions are presented which on the first view tell you that you cannot rid the man of infection with its attendant symptoms. He thought, therefore, that in any case with symptoms of prostatic abscess the earlier incision was done the better.

BOOK REVIEW

GYNOPLASTIC TECHNOLOGY. By ARNOLD STURMDORF, M.D. Philadelphia, F. A. Davis Company, 1919. Octavo, cloth, pages 322.

The *raison d'être* of this volume is the author's opinion that gynoplastic operations have heretofore in a large degree been based on erroneous theories of pathology and unjustified clinical deductions which have for many years had authoritative sanction. He claims that the prevailing principles and practices can not be defended either theoretically or practically in view of the actual anatomical structures involved.

The chief chapters of interest are those dealing with tracheloplasty and with the consideration of endocervicitis, perineorrhaphy, cystocele, fistulæ and the various forms of congenital malformations.

The book is profusely and adequately illustrated with schematic drawings and one is immediately struck by the author's facility of demonstrating his procedures clearly. In all instances he develops the etiology of the various conditions, presents the pathology and shows the reason why certain steps must be taken in order to eventually accomplish certain desired results, and then elaborates the operation proposed based upon these considerations.

The text is readable and interesting. Particular notice should be directed to his treatment of chronic endocervicitis.

Briefly, his method consists of an enucleation of the endocervical mucosa from the external to the internal os and then the accurate relining of the denuded cervical canal by a cylindrical cuff taken from the vaginal sheath. The descriptive illustrations of this operation are particularly full and enlightening. In accomplishing the second stage his technical method of suturing is most ingenious. He condemns very correctly cervical curettage as of doubtful efficacy. He draws attention to the fact that success does not in a large number of cases follow the reapposition of the edges in lacerations of the cervix unless one appreciates the pathology of the coexisting infection which almost universally accompanies these lesions. There is but little question that the correlation between carcinoma of the cervix and a long standing chronic catarrhal endocervicitis is an intimate one, and too active attention cannot be drawn to this pre-cancerous state of irritation.

Throughout the book, in cervical work as well as in dealing with the perineum, the reasons why other surgeons have failed is shown most graphically, and one can on every page learn a practical lesson in technic which may serve him well.

The author's consideration of the mechanism of the intrapelvic support and of the pelvic fascia will well repay close attention. While his

BOOK REVIEW

torical references are given due consideration, the author mentions other observers and their work in order to better establish his own methods in like conditions, and does not attempt to describe previous operative procedures which in his view were basically and anatomically incorrect.

The reviewer, however, does not see why, in the consideration of exstrophy of the bladder (on page 245) the operation of Mayo should be discarded in favor of that by Peters merely because of the statement that the higher percentage of cures obtained by Mayo may be due to his personal operative skill! And one must certainly concede that the principle of dynamics which Mayo has so successfully employed, as suggested previously by Coffey, of implanting the ureters in the rectal wall, is technically more sound than that employed by Peters. Certainly Mayo's results are unique and have not been approached by any other surgeon, which would indicate that his method should be the one elected instead of being discarded, as it apparently is, by the author.

The book will, however, repay its reader on account of the clearness with which difficult questions are discussed.

JAMES T. PILCHER.

CORRESPONDENCE

TRAVELS OF A WIRE IN THE ABDOMEN

EDITOR ANNALS OF SURGERY:

This record of an unique case is offered for publication in the ANNALS. Mr. R. T., aged 40 years, entered the Broad Street Hospital, in New York, on June 18, 1919, stating that he had accidentally swallowed a wire something over five inches long, which he had employed with a small swab for making some application to the posterior nares. The fluoroscope employed at once showed the wire in the upper part of the œsophagus, the upper end on a level with the larynx. The patient suffered very little discomfort from the presence of the wire. While preparations were being made for seizing the wire, another fluoroscopic examination showed that the wire had moved down to the stomach. It rested in the long axis of the patient's body, one end of the wire remaining in the œsophagus while the remainder of the wire transversed the stomach in its own axis.

I advised conservatism in treatment, believing that a wire which could make the round of the pharynx might possibly make the round of the pylorus, and I preferred to defer operation until some need for operative procedure was apparent. Most of us have seen so many foreign bodies traverse the alimentary tract in a harmless way that the mere presence of a wire in the stomach would not necessarily call for operation. My assistants, Dr. Sullivan and Dr. Hammett, argued that a wire in this particular position would be likely to perforate the wall of the greater curvature of the stomach. There really did seem to be such a danger.

The patient was anæsthetized and the stomach opened. The wire was not there, although the fluoroscope clearly showed it in the œsophagus and stomach a few moments in advance of the etherization. There was some speculation as to what might have become of the wire, but we felt that in the course of some efforts at emesis made by the patient while going under the anæsthetic, the wire must have been transferred to the long axis of the stomach and passed through the pylorus. The wound was closed and we planned to make another radiograph as soon as our operative wound had healed, not wishing to move the patient to the X-ray room in the interval unless untoward symptoms developed. Nothing unusual occurred in the course of repair of the wound and there was no undue abdominal tenderness at any point suggestive of the presence of a wire in the free peritoneal cavity. There was no evidence of obstruction in the bowel at any point. The patient's vital signs showed very little variation from normal. The only point worthy of note, perhaps, was the fact that there seemed to be more gas formation in the bowel than would be accounted for by any ordinary disturbance of digestion.

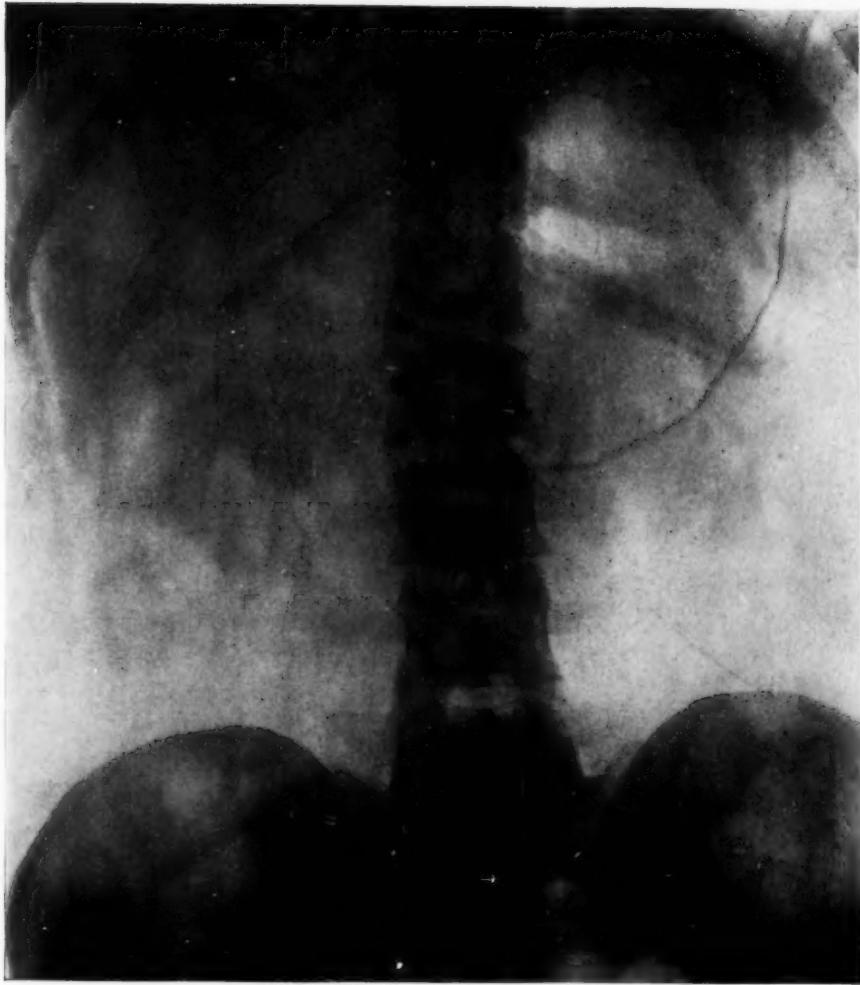


FIG. 1.—Wire in free peritoneal cavity after perforating stomach without causing any notable harm.



FIG. 2.—Wire at rest upon fundus of bladder after traversing peritoneal cavity harmlessly.

CORRESPONDENCE

Twenty days later, the wounds having healed, the patient was taken to the X-ray room, and the wire was found to be outside of the stomach or bowel in the free peritoneal cavity as shown in Figure 1. Other radiographs, beside the one here presented, were made with bismuth in the stomach and bowel, but as the bismuth obscured the wire for picture purposes the radiographs are omitted from the present publication. A series of radiographs taken during the next few days showed that the wire was moving downward in the peritoneal cavity, and two days later it came to rest in the pelvis at the point shown in Figure 2. At this point it remained without further change, and as there were no symptoms indicating its presence I was inclined against operation, believing that it would become encapsulated in peritoneal exudate. One end of the wire, however, appeared to be so close to the iliac vessels that I feared the effect of any further movement of the wire when the patient was walking about. Consequently a suprapubic incision was made and the wire was found encapsulated in peritoneal exudate upon the anterior surface of the fundus of the bladder. The wound healed without complications. I am inclined to believe that the wire would eventually have perforated the bladder and might perhaps have been removed by way of the urethra. There would have been no leaking into the peritoneal cavity because of the amount of peritoneal exudate sealing in the site of the wire.

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DOUBLE INTERVAL ECTOPIC WITH RETENTION OF SIX-MONTHS FETUS

EDITOR, ANNALS OF SURGERY:

Prenatal anomalies are not unusual and historical writings of abnormalities are profuse. This case report is presented, not that it represents anything new or startling in obstetrics, but that it is unique in character. The salient points are the patient's predisposition for extra-uterine pregnancy, in that both tubes at different periods of time were involved; the retention for two years and three months of a known six months' foetus that incapacitated the patient; the prejudice against operative interference; and the second ruptured tubal pregnancy.

Mrs. G., aged twenty-eight, was admitted to St. Vincent's Hospital October 2, 1919, with a symptom complex indicating double ectopic pregnancy with an interim of two years and three months with the retention of foetus.

Menstruation began at sixteen, regular, no dysmenorrhœa, duration six days. Married at twenty-six. Three months later menstruation ceased and was associated with nausea and vomiting, abdominal distress after eating, with cramps and diarrhoea. This continued for five months, when menstruation was re-established, represented by a continuous flow for three

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weeks, ceased for two weeks and then became regular up to July, 1919, when the phenomena developed a second pregnancy. Menstruation ceased and again she suffered from nausea, vomiting, and diarrhoea. On the evening of October 1st, after eating a pear, abdominal distress and pain were severe and continuous and were associated with vomiting and diarrhoea. The patient, pale and anaemic with thready pulse, was nearly exsanguinated.

Physical examination shows a tender abdomen with rigid muscles. Much pain in right lower quadrant. Lower left quadrant, a large irregular mass nodular and of two prominent portions easily determined by sight and palpation. The patient was cognizant of this mass in February, 1917, and noticed its growth till July, 1917, when she had her first severe attack of pain, cramps, vomiting, and diarrhoea, since which time it has remained stationary.

The diagnosis of ruptured extra-uterine pregnancy was confirmed at operation. On opening abdomen, cavity was filled with blood and a ruptured right tubal ectopic was evident. Right salpingectomy was performed and attention directed to enucleation of the foetus in the left quadrant. The sigmoid had completely enveloped its superior and anterior borders, while below it filled the pelvis and was firmly attached to the pelvic colon which showed evidence of compression. Left salpingo-oophorectomy was performed with removal of foetus enclosed in sac intact. The patient made an uneventful recovery and was discharged from hospital October 30, 1919.

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FIG. 1.—Six months foetus removed after two years and three months retention in abdomen. *A*, head; *B*, thorax; *C*, legs and thigh; *D*, cord with remnants of sac; *E*, placenta.